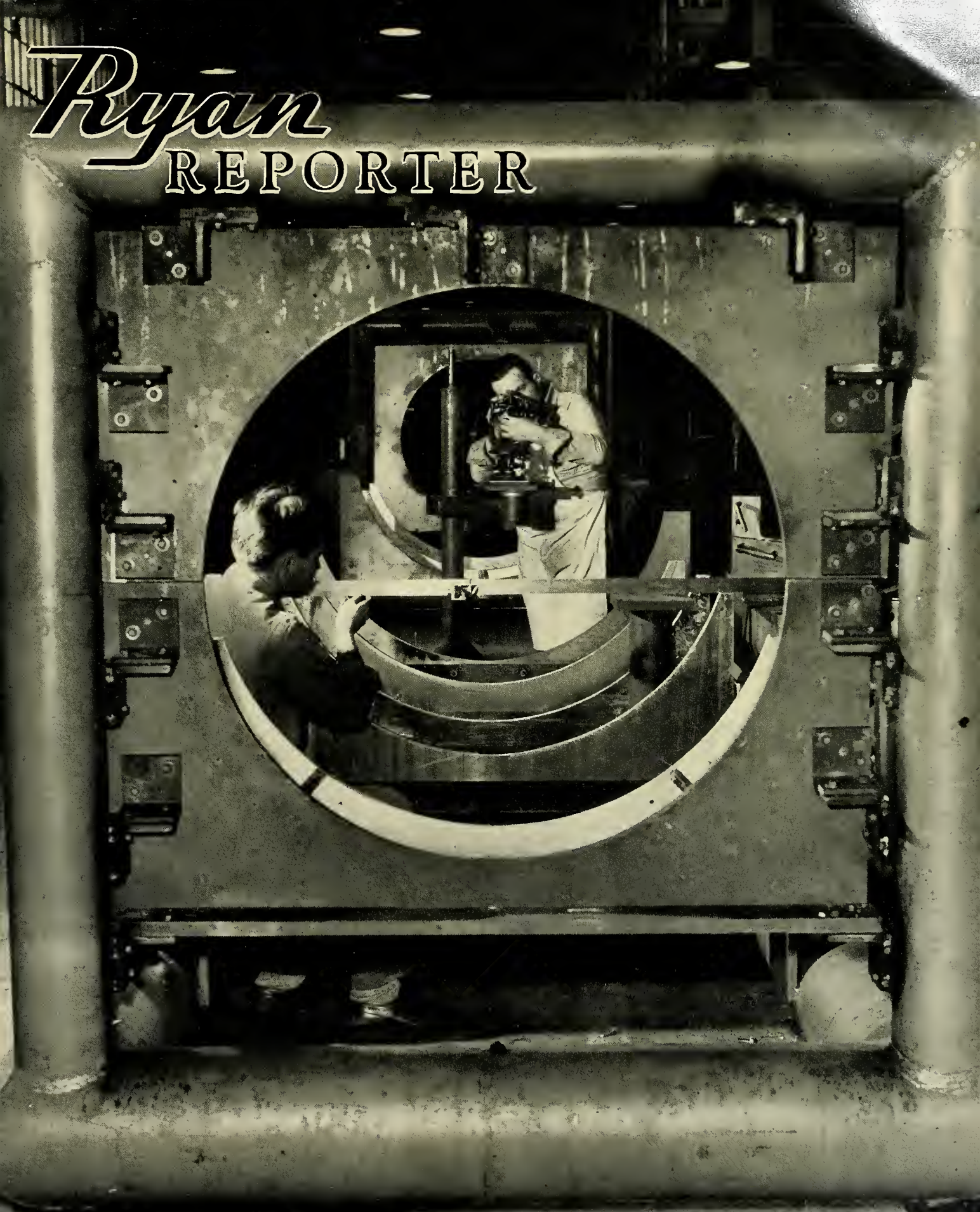
Ryan REPORTER



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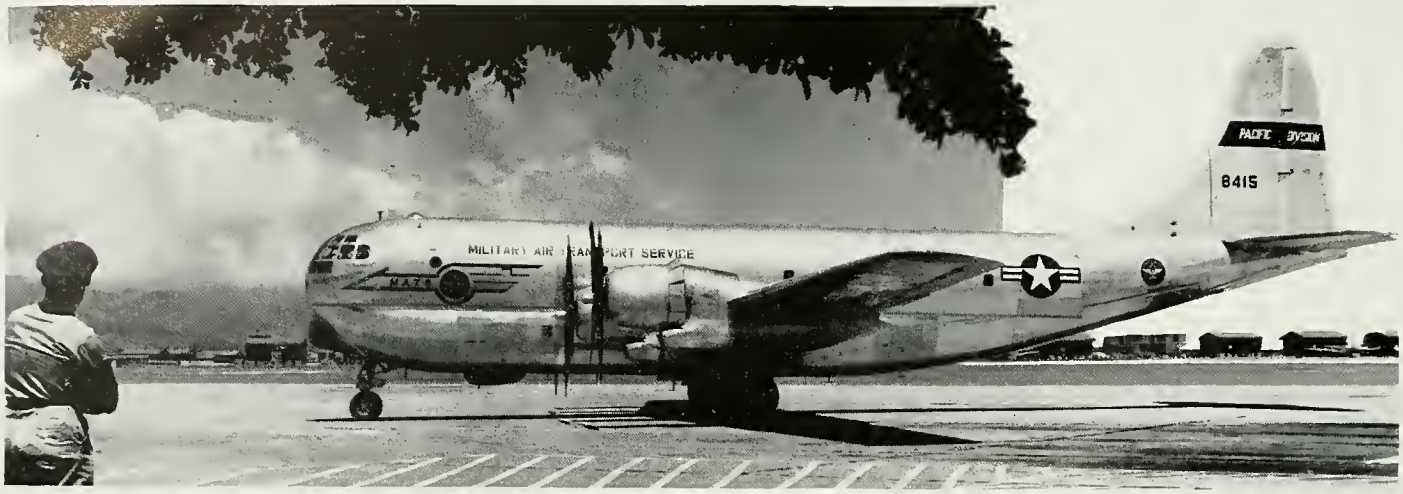


Boeing C-97A Stratofreighter hospital plane, part of the airborne ambulance fleet flown by MATS, stops overnight at Hawaii.

FLIGHT FOR LIFE

by
Lieut. Charles R. DeSpain
Military Air Transport Service

After pause at Army Hospital, Honolulu, patients returning to U. S. are loaded aboard for flight from Oahu to Travis Air Force Base in California. Litter cases are shown being lifted into C-97 through huge cargo doors. Ambulatory patients walk aboard.

THE wounded don't cry.
They just lie quietly on their litters, letting events take their course.

Sure you hear griping, but that's only normal. Tense-jawed, they sigh, "A lot of guys are worse off than I am—I guess I got off lucky."

You hear this from guys who've had an arm or leg blasted off. Guys who've been peppered with shrapnel. Guys with head or chest wounds.

Responsible for air evacuating these wounded veterans of the Korean war is the Air Force-Navy integrated Military Air Transport Service of the United States Air Force. According to the commander of MATS, Maj. Gen. Laurence S. Kuter, 14,000 patients and casualties had been air evacuated by MATS from Japan and the Pacific to the United States up to mid-December, 1950.

Aerial workhorses of the MATS air evacuation project are the huge, figure-eight-shaped Boeing C-97 Stratofreighters. These four-engine flying ambulances complete their aerial jaunt from Japan to Travis Air Force Base, near San Francisco, Calif., in approximately 24 hours flying time. These giant transports airlift from 50 to 60 litter or ambulatory patients on their 5,000 mile journey to California.

Flying out to Japan aboard MATS C-97s, America's fighting men listen to

the drone of the engines and exhausts that rumble off the miles away from home.

But to the battle-tried veterans returning to the States, the muffled thunder of the exhausts seems to sing "Home Sweet Home." With this melodious rhythm soothing their ears, the patients rest assured "it won't be long now."

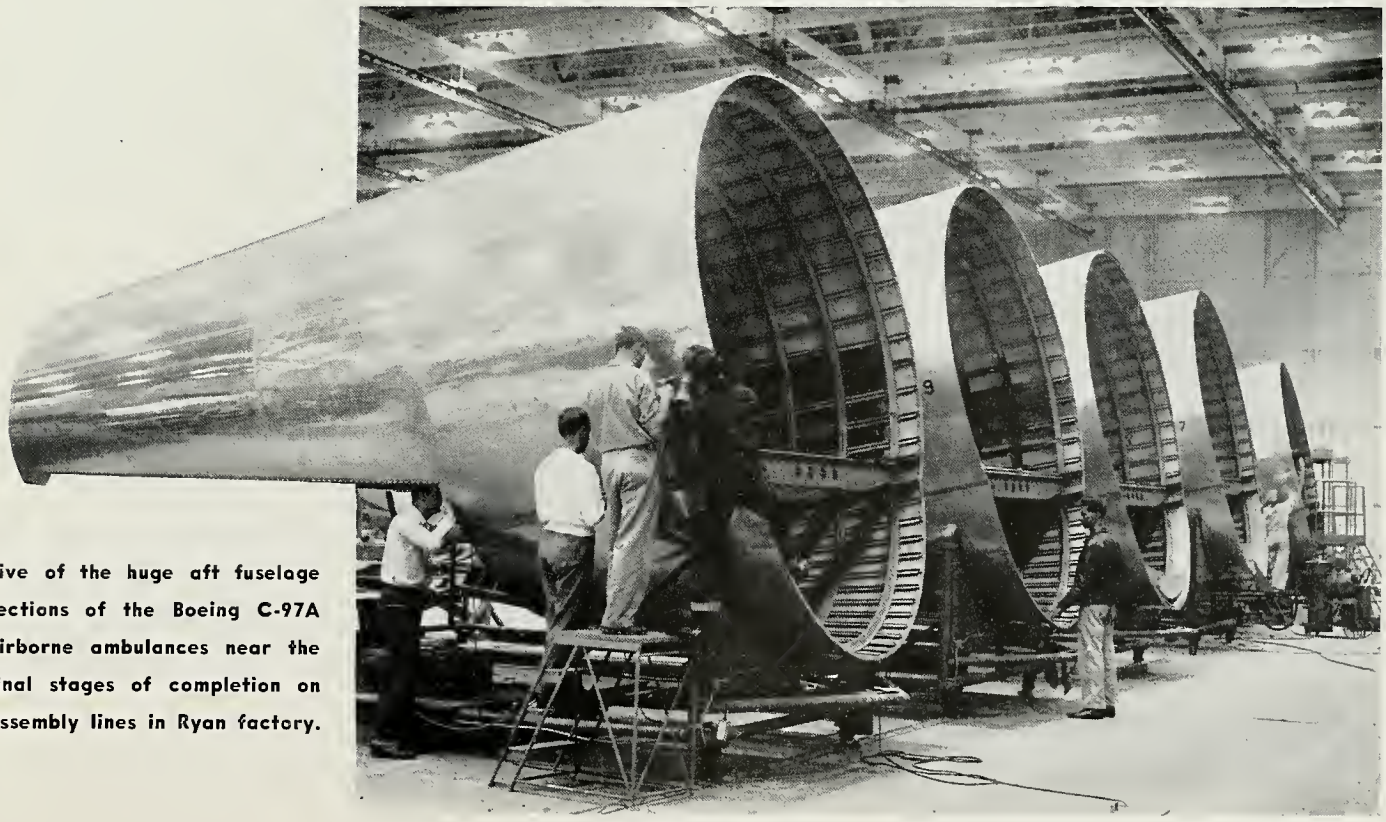
Military medical men foresee the day when surgery will be performed on the lower deck of these airborne ambulances. At present, the lower deck which can accommodate 23 litters, is also being used to transport critical and high-priority cargo and equipment.

The Boeing Stratofreighter's size and steadiness makes it a most adaptable air evacuation plane. But equally important is the pressurization of the aircraft's fuselage. This permits the air evacuation service to handle almost every type of medical case.

Men with chest, abdominal or head wounds ordinarily are not evacuated in non-pressurized aircraft because gas forms quickly in patients' air cavities at high altitudes. This jeopardizes the health of the wounded and complicates the work of the medical staff. Sinus,

(Continued on page 20)

Fork-lift carloaders speed loading of litter patients. Cargo doors and the aft section of C-97 fuselage shown are Ryan-built.



Five of the huge aft fuselage sections of the Boeing C-97A airborne ambulances near the final stages of completion on assembly lines in Ryan factory.

Spotwelding hard-to-reach locations on the outer cones for General Electric jet engines. Especially designed for this work, the spotwelding "gun" is counterbalanced, water-cooled and operated by air pressure control. With extended electrodes it can be inserted into 3-½ inch opening and operate.

INVISIBLE SEAM

Electric Resistance Welding plays an ever increasing role in joining corrosion-resistant steel and aluminum structures.

(Left, above) George Salsbery spotwelds the heat exchanger which Ryan is fabricating for AiResearch. This component is assembled with more than 100 feet of electric spotwelding.

(Center) Ryan uses "spot-tacking" to assemble manifold half-stampings into an accurate position prior to seamwelding. This technique is an efficient and time-saving innovation.

(Right, below) James Griffin directs the movement of an aluminum-alloy structure as it is thoroughly cleaned and rinsed. This is an essential requirement for good spotwelding.

Ronald Caster (left) and Robert Ogier (right) carefully guide a large aluminum tank section between the circular electrodes of a seamwelding machine which is producing a series of overlapping spotweldings, in the Airplane Spotwelding Dept.

INCREASING use of all types of electrical resistance welding in production processes at Ryan is being made in joining corrosion-resistant steel and aluminum structures. Fast, efficient and flexible, this welding technique adds no weight to an aircraft assembly and does not change its physical or chemical composition. Its unique advantages challenge the designer and manufacturer. With it, Ryan is building many new components which could not have been efficiently fabricated a few short years ago.

As a metallurgist would summarize it, all welding is a process of joining metals by the application of heat. Electric resistance welding accomplishes this by passing an electric current through the metals simultaneously with the application of pressure upon them. There

(Continued on page 21)

NAvion SHUTTL

THE man in the street who thinks of air transportation in terms of trips of five hundred to two thousand miles little realizes that the greatest utility of executive planes is often on flights of from fifteen to a hundred miles.

An outstanding example of this seeming paradox is one of the country's top military plane manufacturers. North American Aviation, Inc., original designers of the four-place Navion, retained a fleet of six Navions for just such use when they sold their business plane project to Ryan Aeronautical Company. They find their Navions "just right" for those numerous trips where a multi-engine transport is too large and a company car too slow.

Rushing urgently needed parts to Edwards Air Force Base at Muroc and to other military bases in Southern California is the main job of the Navions which make up North American's own air taxi fleet.

An average of eight round-trip flights daily are made to the Muroc base, a hot, dusty three-hour drive by car to the desert test center. Sandwiched in between are several trips to the Long Beach and Downey plants, each 15 miles away, and many non-scheduled special flights.

The rugged Navions have logged more than 1,500,000 miles in three years of flying—most of it within a 100-mile radius of the Los Angeles, California plant. In addition to delivering parts, the Navions carry passengers, inter-plant mail, fly photo missions and even serve as observer ships when new jets are being tested.

Equipped with VHF radio, flares and gyro compasses, the Navions are ready for any emergency. Several times they have stepped in to play the hero's role as ambulance ships to evacuate seriously ill men from Muroc or as search planes to locate air crash wreckage.

When Crew Chief Bill Purkey's appendix started acting up, a Navion was dispatched immediately to rush him 86 miles from Muroc to the Los Angeles plant and a waiting ambulance. Back at work now, Bill credits the speedy Navion trip to the hospital for his quick recovery.

Everything from nuts and bolts to such bulky equipment as a complete F-86 fighter canopy and XB-45 nose wheel have been carried in the Navions. Frequently it has been necessary to remove the plane's canopy to hoist big parts aboard. Then, the canopy is replaced, the pilot boards, and a badly needed part delivered in a hurry.

Don Nemec is one of five utility pilots assigned to the Navion group. He and most of the others have extensive combat time and average well over 5,000 hours in the air. Don, Bob Bryson and Bud Poage also fill in as test co-pilots on either the B-45 jet bomber or AJ-1 attack airplanes when not flying the Navion.

George Mountain Beere Lane, who

Navion pilot George Mountain Beere Lane hands an F-93 part to Mechanics Bill Mulford, Gordan Ashby and Elmer Atkins at Edwards Air Force Base.

FLEET

first flew in 1914, claims he has more time in a Navion than anyone else in the country. Holding down the swing shift is Art Wagner who has put in almost 400 hours of night flying since joining the Navion group last July.

"Switching from a Navion to a 600 mph jet isn't too difficult," Poage, who bagged eight German planes before being shot down and taken prisoner, declares. "The difference in size, though, is more noticeable than the speed."

From Los Angeles to Edwards AFB at Muroc is about 45 Navion minutes, and includes topping the 8,000-foot San Gabriel Mountain Range. Waiting for the Navion pilot as he taxis up to North American's hangar at the huge Air Force test base there's usually a knot of grimy, sweat-stained mechanics.

"Got the regulator?" Jack Canary, service engineer on NAA's hot F-93 contract, may yell as the pilot slides back the canopy.

"Sure, give me a hand," is the reply.

A few minutes later the regulator will have been installed and the new F-93 fighter taxied out for an important test flight.

"Getting that part up here today will just about keep us on schedule. We couldn't do a darn thing 'til we got it," Canary concludes.

Much of the credit for a safety record which stretches through 17,000 separate trips in three years goes to Ken (Arky) Huggler and his maintenance crews. In addition to a daily safety inspection each Navion gets a thorough check every 50 hours and complete stem to stern overhaul every 1,000 hours.

"We keep 'em pretty fit," Huggler, who helped build the first Navion and has been working on them ever since, admits. Helping him are Bob Linn, Walt Wells and George Neidhard, all top notch mechanics.

Keeping the Navion operation running smoothly and getting the planes where they're needed at the right time is the job of Dispatcher Charles Matkin.

"We've flown everyone from janitors to generals in the Navion," Matkin proudly declares. "Our records show more than 15,000 passengers and nearly 80,000 pounds of parts transported without a serious accident."

Chairman of the Board J. H. (Dutch) Kindelberger has been a frequent passenger, and Henry Du Pont, member of the Board of Directors, has even taken over the controls briefly while flying to Muroc.

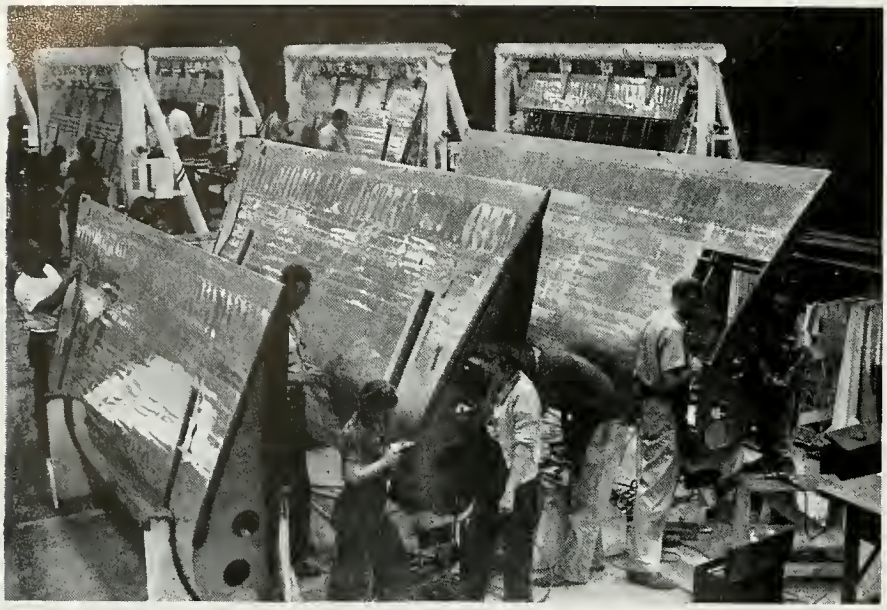
Need for a specialized transport service was noted for the first time in 1946 when the FJ-1 Fury flight test program was moved to Muroc. Gas-thrifty Navions, then being built by North American, proved to be just the thing to keep a close liaison with the desert operation.

When the Navion program was sold to Ryan in 1947, it was decided to keep six airplanes for North American's own use. One was flown to Washington, D. C., and the others formed into the Navion transport group.

"Now we'd have a dickens of a time running our test program at Muroc without them," declares George Mellinger, Chief of Flight Test.

Waving a Navion into place on the North American ramp for an inspection is Ken Huggler who helped build the first Navions.

MATERIAL THROUGH COURTESY **North American Skyline**



Wing flaps of "B" series B-36 bombers are rebuilt by Ryan for Convair modification program. Planes are converted to "D" models by adding jet pods.

AIR BRAKES for the B-36

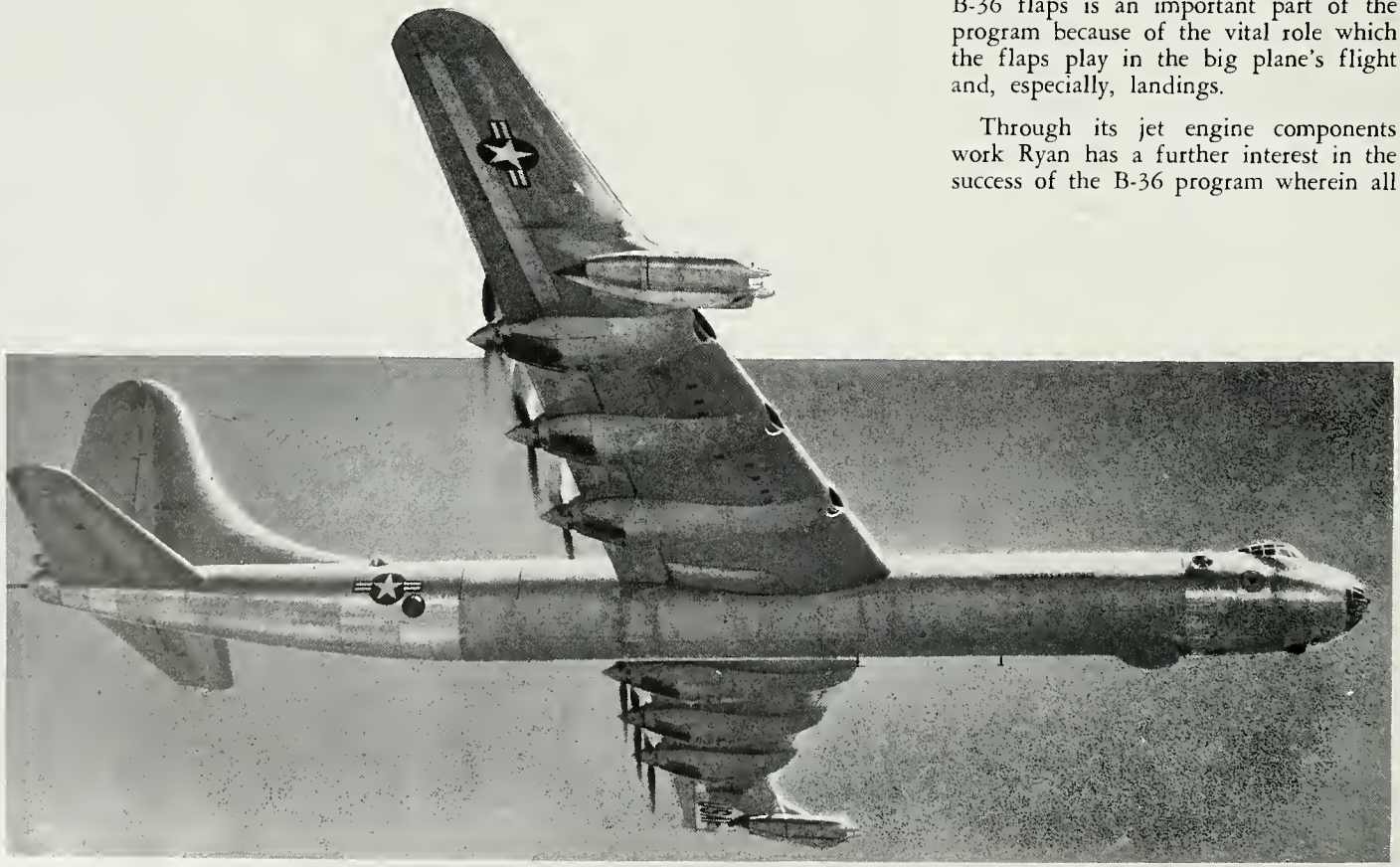
MODIFICATION and complete rebuilding of the huge wing flaps of an undisclosed number of early-model "B" series of B-36 intercontinental bombers is currently under way at Ryan in conjunction with work which Convair is performing on the B-36s to augment their speed and power and convert them into "D" model airplanes.

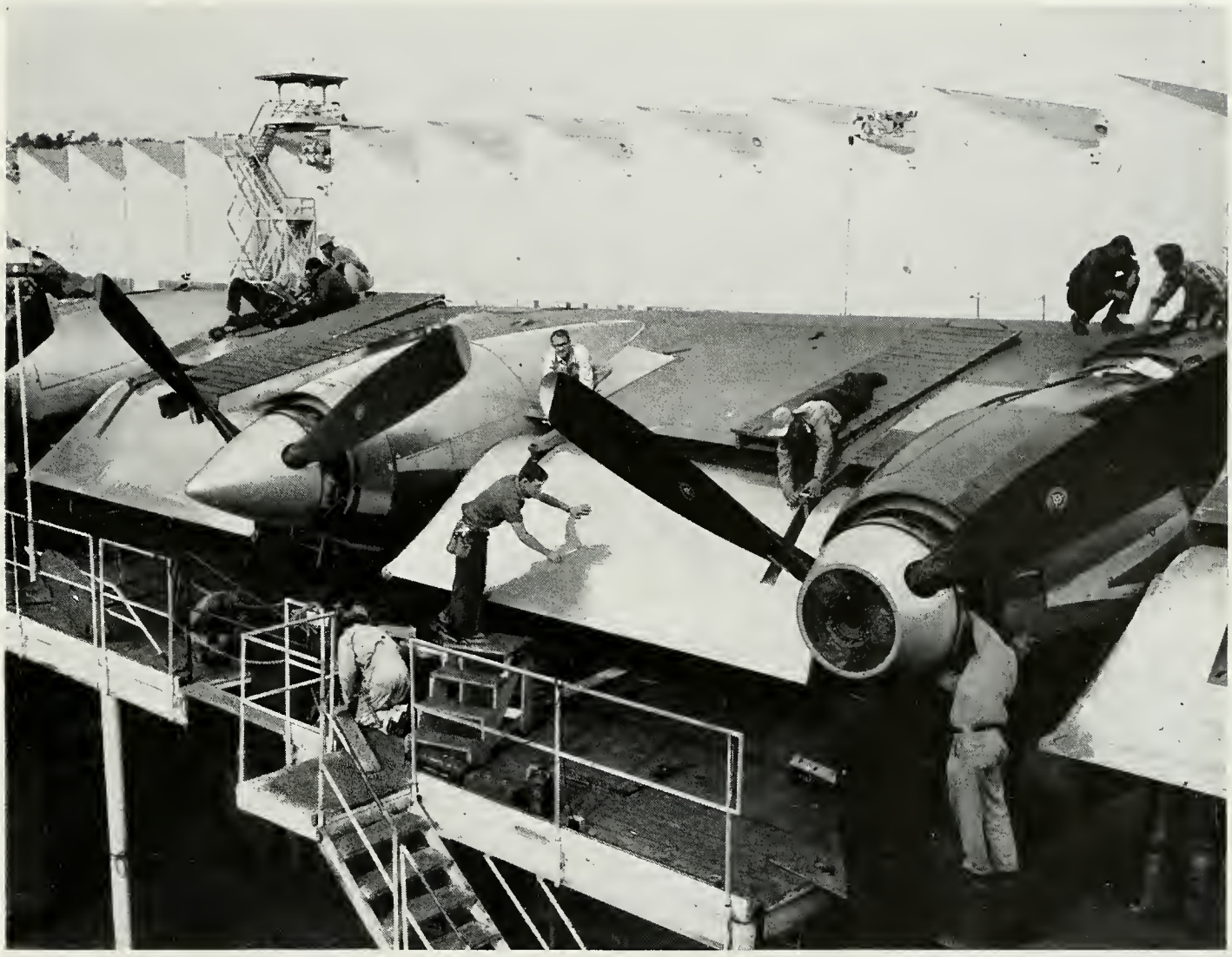
Designed with six 3,500 h.p. Pratt & Whitney "pusher" piston-type engines, the mighty bombers are getting four additional General Electric - J-47 jet engines mounted in pairs in pods under their 230-ft. wing spread, at Consolidated-Vultee Aircraft Corporation's San Diego plant.

Although specific performance is secret, the modified ten-engine series "D" model of the world's biggest warplane can fly more than 435 m.p.h. at altitudes above 45,000 feet and pack a herculean 10,000 lbs. of destruction on a combat mission of 10,000 miles nonstop, without mid-air refueling. With its four jet and six piston engines, the improved strategic bomber has a total of approximately 42,000 h.p.—more than any other known aircraft.

In conformity with this stepped-up performance, the airplane is being modified and strengthened to sustain the increased air loads imposed. Ryan's work on the B-36 flaps is an important part of the program because of the vital role which the flaps play in the big plane's flight and, especially, landings.

Through its jet engine components work Ryan has a further interest in the success of the B-36 program wherein all





After flaps are rebuilt by Ryan, workmen install them on B-36 modernization line at Consolidated Vultee's San Diego factory.

these huge bombers are being equipped with supplementary jet power plants. For General Electric, Ryan builds inner and outer exhaust cones, combustion chambers, transition liners and other parts for the J-47 engine. For Bell Aircraft, which has the contract for building the "pods", Ryan makes the jet engine tail cones which carry the volcanic jet engine gases to the outer air.

The first of the modified B-36Ds from the San Diego Convair plant have been completed and test flown, and are ready to rejoin operating squadrons. In the flight test work, too, Ryan has an interest, for the chief pilot assigned to this work is Phil Prophett, graduate of the Ryan School of Aeronautics commercial pilot training course and later a civilian squadron commander in Ryan's wartime military pilot training program which was conducted under contract to the then U.S. Army Air Corps.

Each B-36 bomber has six Fowler-type flaps (spaced between the pusher engines) which are used to slow the bomber for landings and develop greater lift for loaded take-offs. Each flap is approximately 14 feet long, 6½ feet wide and weighs in the neighborhood of 200 pounds. When received at Ryan, the flaps are stripped down by removing all surface skins except the leading edge. This is left intact, unless damaged, because it sustains no substantial stress in flight. Every bit of removed material—old skins and all scrap—is carefully saved in individual containers and returned to Convair to give the Air Force an exact record of the weight removed.

After stripping down to the rib structure, the flaps are taken to the Ryan paint shop and washed with thinner to remove all dirt and contamination. A meticulous inspection follows and a listing is made of any evidence of damage to ribs and leading edge. These defects are repaired by installing hand-made doublers and reinforcing plates to fit previously made rivet and screw holes as much as is practical. A complete set of upper and lower skin surfaces and stringers is fabricated and located on the flap

(Continued on page 22)

From railway cars unloading at far left, past storage buildings to new truck dock, Receiving area is spacious and well organized.

WELL RECEIVED

A LONG time ago someone came up with the title of "Receiving" for the department that is logically the first key to success of a factory's productive operations.

One has only to spend a day in the Ryan Receiving Department to realize that this label, with the passive picture it creates of somebody sitting back waiting for deliveries, is a grand misnomer. More descriptive would be a functional name like "Supply" or "Distribution Center". Nowhere is there greater need for speedy handling of materials; fast, accurate inspection and careful record keeping.

With 40 big trucks bringing in loads of raw stock and supplies each day, nearly as many private automobiles and pick-ups adding their share, and three railroad cars demanding immediate unloading every two days, it's evident that Receiving must be either crack expediter or exasperating bottleneck. Thanks to conscientious carrying out of duties by all employees, resourceful leadership and modern procedures and equipment, Ryan's operations stand alongside the best in industry.

Among the many specific reasons for this reputation is the receiving facility itself, newly improved with 25,000 square feet of outside unloading area surfaced in concrete, a large covered truck dock, double-track siding from the main line of the Santa Fe Railroad, and spacious buildings for storing materials.

A wide variety of cranes, lifts, hoists and in-plant motor trucks provide the muscle for unloading hefty steel sheets from railway cars as well as the finesse for moving fragile or delicate instruments.

Well-devised routing methods help, too. Heavy transport trucks now have a gate of their own for entering the factory area; don't fight with lighter-tonnage traffic at the main company gate. Driving through their special entrance the "big boys" have only forty yards to roll to reach a recently completed concrete unloading dock built for their exclusive use.

E. R. Wiles, F. T. Delaney and H. V. Bilben: Responsible for fast, unerring Receiving and Inspection.

The large raw stock storage room is also located conveniently on a straight-away, unobstructed course from the gate, should the load be aluminum or steel sheets and bars.

Smaller vehicles, passing through the main gate, are lightened of their contents at a different unloading space. Similarly there's a special area assigned to the swift unloading of the flat, freight and "gondola" cars routed along the rail siding. Seldom is their conflict among the various types of delivery.

And in emergencies, transport aircraft taxi right up to the Ryan gate facing Lindbergh Field to deliver high priority shipments. C-47's from Alamagordo, New Mexico, and other Air Force bases employ this means of delivery whenever vital parts for their contract work are needed at the factory. Normal air freight carried by major airlines is picked up at the terminal across the field by Ryan's own trucks, is ready for inspection minutes after arrival in San Diego.

With 800,000 lbs. of materials and machinery being received monthly from hundreds of vendors, there's a certain percentage of "partial deliveries", "over- and short-shipments", "wrong deliveries", "damaged shipments" and other "discrepancies" that only the deftest

Receiving office has efficiency, "room to work in". Here clerks prepare the manifest and reports covering all shipments received.

type of record keeping can hope to keep up with. That's where Receiving Supervisor Frank Delaney and his staff operate under additional pressure. They apply the brakes to normal transfer of the shipments concerned until decisions on what will be done with them are made by Materiel Control, Engineering and Purchasing.

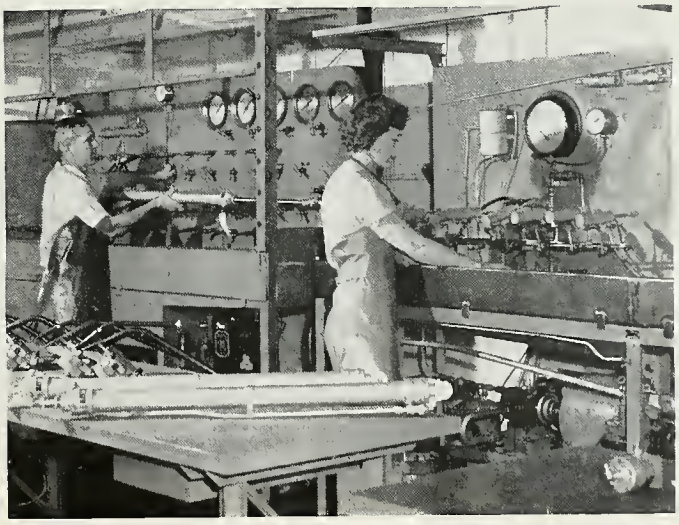
Delaney's a hard man to catch at his desk. Most often he is in the main Receiving Building where materials received from trucks are quickly dispatched among seven different processing zones. In one zone are collected packages received by air carrier, parcel post, or that are marked for "Special Handling". Another section labeled "Hold" is headquarters for

(Continued on page 17)

Machined parts like these steel rings for General Electric jet engines are individually inspected with precision instruments before their transfer to assembly area.

Motor lift trucks are used to remove raw stock steel and aluminum from freight cars to store rooms for inspection.

Hydraulic equipment destined for Stratofreighters and Navions is carefully checked on special testing stand.



CLANCY'S NEW BOOM

The streamlined control "pod" for Clancy, the refueling boom operator, fits into cargo-door section of Boeing C-97A transport.

By C. J. Leisy, Project Engineer, In-Flight Refueling, Boeing Airplane Co.

Designed as a practical means of greatly extending the range of U. S. Air Force aircraft, the Boeing-developed Flying Boom is seen here in action. "Clancy" is flying the boom into position to transfer gasoline from B-29 tanker to the B-50 bomber.

THAT lyrical Irishman, Clancy, has a new boom.

"Clancy", the appropriately chosen nickname of the modern aerial gas station attendant, grew up at the controls of the telescopic refueling boom of a KB-29P aerial tanker. Now Boeing has equipped him with a new "Flying Boom" in the recently announced tanker version of the versatile C-97 Stratofreighter.

Like the Boeing KB-29P tankers already in service, the KC-97A Flying Boom prototype is designed to make mid-air refueling contacts with B-50D Superfortress bombers. The new modification now makes a triple-purpose plane of the Air Force's 300-mile-an-hour C-97 double-deck troop and cargo Stratofreighter.

With tanker equipment removed, the KC-97's can carry either 135 combat equipped troops, 83 litter patients with their medical supplies and attendants, or up to 68,000 pounds of freight which could include jeeps, trucks or artillery weapons.

The C-97 and B-29 aerial gas stations make possible the refueling of U. S. Air Force bombers and fighters at higher speeds and greater altitudes, and at a much faster rate of flow than was possible with earlier hose-and-reel fueling systems. Serving as 'wet nurses", the modified Boeing tankers permit bombers and other combat aircraft to take on additional fuel while in flight, thus greatly extending their range and load carrying possibilities.

As one example of what the new system actually does, consider our medium B-50 bombers which it turns into intercontinental bombers. With its normal fuel supply, the 400-mile-an-hour B-50's can carry a 5-ton bomb load 6,000 miles. Details of its range and load with in-flight refueling are not available but some conception of the increased scope of operations is gained by realizing that a full tanker load involves the mid-air delivery of thousands of gallons of high-test aviation gasoline.

(Continued on page 16)

With its equipment standard on Boeing "Flying Boom" Tankers, Ryan has a stake in the newest developments in Aerial Refueling.

New Look In ENGINEERING

As part of a plan of expanding facilities of all departments as required to take care of Ryan's increasing role in the defense program, the Engineering Department has just been moved to larger, more spacious quarters. At the same time, the engineering organization has been streamlined for maximum effectiveness, and a new executive staff has been named to head Ryan Engineering activities.

Recently appointed to the key post of **Director of Engineering** is **Bruce Smith.** A veteran of 20 years aircraft engineering experience, Smith was previously Chief Engineer of the company's Airplane Division. Prior to joining Ryan, he had been nine years with Consolidated Vultee as Chief Design Engineer.

Principal aide to Smith in the new engineering organ zation is **William T. Immenschuh.** A veteran Ryan er ployee, Immenschuh was promoted to the new post **Executive Engineer** following more than ten years in d sign work on Ryan military contracts including experience project engineer on the Ryan Fireball series of jet-plu propeller Navy fighters and on other still-restricted develo ment programs.

For administrative purposes, engineering responsibiliti are now divided between Production and Development se tions. In charge of **Production Projects** is **Richard White,** veteran Naval aviator and former Commander wh

(Continued on page 18)

SPACIOUS NEW QUARTERS. Main engineering room provides generous space and excellent lighting. Project engineers have offices at left

NEW ADMINISTRATIVE STAFF. Heading up Ryan's efficient, streamlined engineering organization are these top executives, each with extensive industry experience. Left to right: H. E. Braasch, Bruce Smith, Director of Engineering, R. E. White and W. T. Immenschuh.

d executive offices and library, center, is production engineering group.

CARIBBEAN ATLANTIC LINES USE THEIR NAVION TO COVER MOUNTAINOUS TERRAIN

SAN JUAN, PUERTO RICO. (Special)—Serving a mountainous terrain, Caribbean Atlantic Airlines reports complete satisfaction with their Navion which they have been using for many weeks in their air operations. Only scheduled air-carrier based in Puerto Rico, CARIBAIR operates between that island, the Dominican Republic and the Virgin Islands.

The Navion was placed in service when the airport at Ponce, Puerto Rico's second largest city, was put out of operation due to unsatisfactory maintenance. A small private field, owned by the manufacturers of "Don Q" rum was substituted for use there. However, because of its limited size, the regular DC-3's of the airline could not operate from this airport and the Navion was obtained to continue service to Ponce during the time the main airport was being reconditioned. For many weeks, this Navion has made two round trips daily between San Juan and Ponce.

Navions 'round the World

NAVIONS CHOSEN FOR THE ROYAL IRANIAN AEROCLUB

TEHERAN, IRAN. (Syndicate)—Destined to fly thousands of miles over the hot sands of Iran, these three Ryan Super Navions have recently been delivered to the Royal Aviation Club at Teheran.

The Royal Aviation Club, whose President is Shah Pahlevi, selected the Super Navions because of their high performance and exceptional ruggedness on the rough fields and deserts of Iran. Influencing the Iranian officials in their choice was the fine record of performance of the Navion fleet which is operated by Arabian-American Oil Company in nearby Saudi-Arabia.

ARCHBISHOP OF MEXICO BLESSES PLANES AFTER FIRST RIDE

CHICONCUAC, MEXICO. (Exclusive)—Monsignor Luis M. Martinez, Archbishop of Mexico, recently made his first flight, in a Ryan Navion owned by Raul Cervantes Ahumada of Mexico City. He was very enthusiastic about his experience and expressed his keen appreciation of the comfort and utility of the Navion for use in Mexico where surface travel requires six to seven times the time scheduled for flight. The Archbishop visited Chiconcuac to bless a gathering of private planes assembled there for the opening of a new private airport sponsored by Cervantes Ahumada.

NAVIONS FEATURED IN AERONAUTICAL FESTIVAL IN MONTEVIDEO, URUGUAY

MONTEVIDEO, URUGUAY. (Feature Service) — One of the interesting events sponsored by Miller, Medeiros & Bastos, the Ryan Navion distributor for Uruguay, is an aeronautical festival. Popular with the large number of Navion-owners in Montevideo, this get-together is held twice a year. Such activities as this are undoubtedly responsible for the high per capita ownership of Ryan Navions in Montevideo. In addition to private owners, Navion fleets are operated by the Aeronautica Militar (Air Force), the Sanidad Militar (Government Health Agency) and the Centro Aviacion de Salto (State Health Agency) with excellent results.

NAVION CHOSEN FOR PRESIDENT OF CHILE

SANTIAGO, CHILE. (Special Feature)—Recently completing a speedy flight from San Diego, California, to Santiago, Chile, Captain Jose Berdichewsky and Lieut. Jorge Rojas have delivered a new Ryan Super Navion for the special use of President Gabriel Gonzalez Videla. Designated with the Presidential markings "01" and maintained by the Air Force of Chile, this Super Navion will be used to transport the President to many cities of Chile at which the airports are too limited in size to serve the larger Presidential transport. Formerly the President of Lineo Aereo Nacional, Chile's national airline, President Videla's choice of the Super Navion was based upon his wide aviation experience.

FRANCE'S LEADING WORLD WAR II ACE PRAISES FIGHTER-LIKE MANEUVERABILITY OF NAVION

MARSEILLES, FRANCE. (Special)—Highest praise for the fighter-like maneuverability and steep landing approach facility of the Ryan Navion was expressed by Pierre Clostermann, France's leading Ace of World War II. Flying in the Ryan Navion owned by Mr. Roland Froissinet, publisher of Marseilles' leading newspaper, LE MERIDIONAL, Clostermann performed a blind instrument landing at Lyon Airport to top off his thorough flight check of the airplane. Clostermann is credited with 33 official enemy aircraft shot down, 5 probable and many tanks, locomotives and 1 submarine as the result of his service with a French Fighter Squadron. He has also written a best selling book, based on his wartime experiences, entitled "The Big Circus." Mr. Fraissinet, who obtained his Navion through ANCO, Inc., European Ryan Navion distributor, frequently uses his airplane for dramatic ten-minute aerobatic demonstrations at air shows throughout France.

ISLAND HOPPING IS DAILY ROUTINE FOR NAVION OWNER IN HONOLULU

HONOLULU, HAWAII. (Special)—"Our Navion performing beautifully. No other plane in any price range could serve our purposes as well," writes Lee Maice, enthusiastic Navion owner flying in the Hawaiian Islands. Using his Navion for inter-island flights from Honolulu, Maice states, "The Navion is comfortable, safe and fast."

Upon the occasion of the recent visit by Arthur Godfrey to Honolulu, Maice extended an invitation to the radio star to feel free to fly the Navion while there. Godfrey is a long-time Navion owner and booster for the airplane on many of his radio broadcasts and television shows, and uses his Ryan Navion to commute between his Virginia farm and New York office.

Painted green with white markings and gold trim, Maice's Navion attracts much favorable comment at the airport in the Island.

TWO NAVIONS PURCHASED BECAUSE OF HIGH ALTITUDE PERFORMANCE AT BOGOTA, COLOMBIA

BOGOTA, COLOMBIA. (Exclusive)—Picking up two Ryan Super 260 Navions at the factory and flying them to Bogota, Mauricio T. Obregon, Hernan Echavarria, Juan Esguerra and Mr. and Mrs. Francisco Esguerra have cabled their keenest expressions of admiration for the Super Navions' superlative performance. "The Super Navion is certainly the most stable cross-country plane which we have had the opportunity to fly. All of the instruments are good, especially the A.D.F. which is a positive marvel. Everyone agrees the Super Navions are the most completely equipped private planes to arrive in Colombia."

This delivery was handled by the AEROCLUB DE COLOMBIA, Ryan Navion dealers for Colombia. The Super Navions were purchased because of fine performance at the 9500 ft. altitude of Bogota.

Gravity-feed refueling, through a flexible hose extending from the tail of a Boeing B-29 tanker, was used during the round-the-world non-stop flight of a B-50. Superfortress "Lucky Lady II" was refueled four times on globe-circling trip.

CLANCY'S NEW BOOM

(Continued from page 11)

The Flying Boom system can be used to fuel jet fighters also. Tests have been made with the Republic F-84, it has been announced. One such refueling nearly doubles the jet's flying range.

As a result of flight test work which was begun in the summer of 1948, the 'Flying Boom" refueling system is being installed on an assembly-line basis at Boeing's Renton, Washington, plant, and the first of the KB-29P aerial tankers already are in service. The 97th Aerial Refueling squadron at Briggs Air Force Base, El Paso, Texas, was the first U.S.A.F. squadron to get the new tankers.

Among companies contributing their skill and production know-how to Boeing's recently enlarged manufacturing program is Ryan Aeronautical Company. Not only does Ryan build the stainless steel exhaust systems of the Boeing B-29's, B-50's and C-97's, but in addition they are fabricating the huge aft fuselage sections, cargo doors and all floor beams of the C-97 Stratofreighters. Understandably, Ryan has a large stake in the success of Boeing developments in aerial refueling.

The Flying Boom system utilizes a long telescoping refueling boom extending from under the tanker's tail. This flying gasoline pipe is equipped with small vee-shaped 'ruddevator" control surfaces which enable the boom operator — "Clancy" — to govern the movements of the boom up or down, or to either side. As the planes fly in formation—the tanker in front and slightly above the B-50 Superfortress receiver plane—the boom is telescoped down and out from beneath the tanker.

A crewman in the rear turret of the B-29 - - "Clancy" - - operates the controls and flies the nozzle directly into the fueling socket which is located just forward of the upper gun turret of the B-50 receiving plane. Fast "coupling-up" and quick "disconnect" are features of the system, as well as rapid, pressure-type fuel transfer. The Flying Boom is retracted and secured to the tanker body during takeoffs, landings, and in flight, except during the actual flight refueling operation.

In the C-97 tanker version, the boom operator's station and base of the boom are underslung beneath the fuselage where the Ryan-built cargo doors are normally located. A bracket beneath the tail holds the boom in a retracted position so it does not extend as far behind the tanker as in the case of the KB-29P.

Successful refueling contacts with the B-29 tankers have been made at night and in adverse weather, according to Lt. Col. William H. Reddell, who commands the 97th Refueling Squadron. The equipment, he says, is "simpler, quicker and more versatile as to weather conditions." All-weather operation of the flying gas station is greatly aided by the anti-icers on the "ruddevator" leading edges which have electrically heated wires embedded into the rubber covering.

The Flying Boom system was developed to make possible refueling at higher altitudes, air speeds and rates of transfer than are possible with the earlier method of gravity-feed refueling through a flexible hose. This flexible-hose method of refueling was used in February-March, 1949, when the Boeing B-50 "Lucky Lady II" flew around the world non-stop in 94 hours, with in-flight refueling by tanker B-29's accomplished at four points —the Azores, Arabia, the Philippines and Hawaii—on its 23,452-mile route.

Some units of the Strategic Air Command medium bomber groups are already equipped with the hose-and-reel fueling systems installed in KB-29M's by Boeing-Wichita using equipment constructed by the British Flight Refueling Ltd., basic refueling method. Soon each of nine medium bomber groups will have 20 Flying Boom Tanker planes added to their complement.

MANY REFUELING METHODS TRIED IN PAST 27 YEARS

Air-to-air refueling got its start at San Diego on June 25, 1923, when Captain Lowell H. Smith and Lt. John P. Richter kept an Army DeHavilland biplane in the air 37½ hours. (Pilot of the "nurse" plane was Lt. Frank Seifert, later representative of the Ryan Aeronautical Company at Washington, D. C., and after that a World War II Colonel—Editor.) The refueling system was simplicity itself—a hose was merely lowered from the refueling plane at the end of a rope and gasoline was gravity-fed into the endurance plane.

By 1929, the U. S. Army began to fully realize the strategic advantage of extended bomber range through in-flight refueling and sponsored the famous "Question Mark" endurance flight of 150 hours during which 43 refueling contacts were made. Top airmen in charge of the flight of the tri-motor Fokker were Major Carl Spaatz and Captain Ira Eaker, both World War II generals, now retired.

With the technique pretty well proven, and stimulated by post-Lindbergh era enthusiasm, commercial pilots for the next year or so engaged in many refueling endurance flights, often remaining aloft hundreds of hours.

SUBSEQUENTLY, a much more serious approach to flight refueling was undertaken in England under the direc-

(Continued on next page)

Wide World Photo

Republic F-84 jet fighter gets gas supply in mid-air using British "probe-drogue" refueling method.

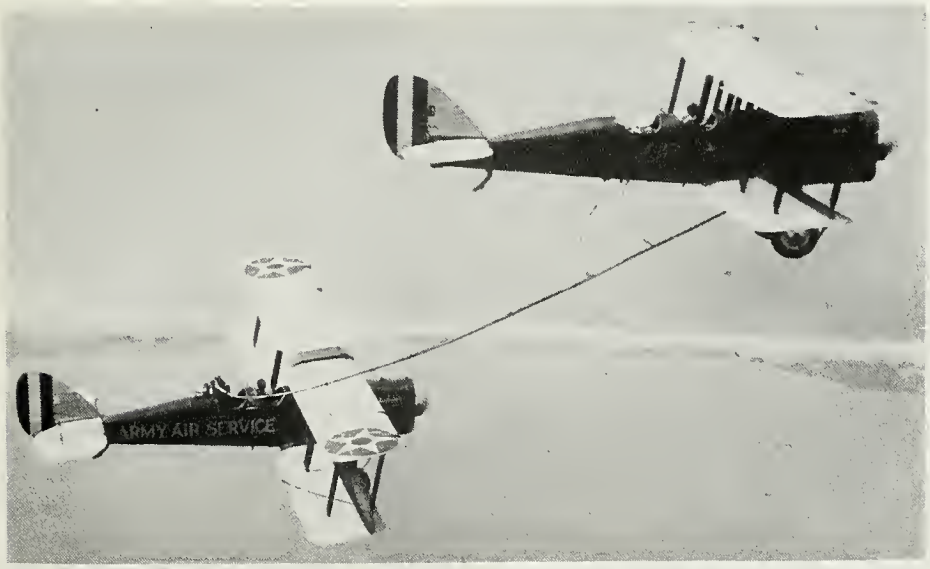
tion of Sir Alan Cobham, the well-known British distance flier. Out of that came an organization known as Flight Refueling Ltd., which, during five years of active research, investigated several dozen systems of contact and fuel transfer. Most of this work was pre-World War II, and was directed more toward a suitable technique for non-stop trans-Atlantic commercial transport flying than in the direction of the extension of bomber range.

In 1945, the Air Materiel Command Power Plant Laboratory introduced the "continuous-flow fuel system" which permitted the refueling of all tanks from a single readily accessible point on the plane, and was considered a necessary antecedant to air-to-air refueling of bombers. The B-29, for example, originally had 29 tanks with 11 different servicing points. Under the single point system, one man and one truck can now fuel up a B-29 in 30 minutes.

Another development of the Flight Refueling organization is the probe-drogue system. This uses a hose with a trailing funnel-like drogue at the end to hold the fuel hose steady. The airplane being refueled (in most cases a jet fighter) is equipped with a projecting probe which the pilot flies into the drogue. As soon as a solid contact has been established, fuel flows in at a high rate of flow under pressure. When the tank is filled, the system shuts off and the jet fighter breaks formation. In a recent trans-Atlantic jet fighter refueling operation with a Republic F-84, both British and American tanker planes were used for refueling.

After the war, Boeing teamed up with the U. S. Air Force and Flight Refueling of England to further develop the hose-reel system for the B-50 Superfortress "Lucky Lady II" non-stop round-the-world flight. In this system fuel was gravity-fed, which meant that contact periods were far too long for practical military purposes.

Even before this, however, Boeing had begun work on its own "Flying Boom" project, feeling that a rigid tube system with pressure fuel pumping would overcome the disadvantages of the flexible-hose method. Success of the B-29 and C-97 tankers confirms the advantages of the Boeing-developed telescopic pipe system.



First recorded air-to-air refueling was made over San Diego in 1923 when the Army kept a deHavilland biplane in the air 37-½ hours. A hose was lowered from refueling ship at end of rope and gasoline gravity-fed to endurance plane.

WELL RECEIVED

(Continued from page 9)

the discrepancy shipments mentioned earlier, including shipments for which no covering Purchase Order can be found. Also in the Hold area are items that need Ryan "asset tags" to properly identify them as permanent machinery, furniture or other equipment of the company. Four zones set-up for prompt, routine handling of normal shipments are cleared away every morning and afternoon by Transportation, a department closely allied with Receiving.

As a shipment is unloaded and routed to one of the processing zones, it is given an "ID" tag with a number corresponding to that which will appear on a Receiving Report to be prepared for completely identifying the shipment.

Delaney personally checks on the processing zones from hour to hour making sure that received materials are leaving the spaces promptly.

Administrative nerve-center for the department is located at the desk of Carrie Williams, seven-year Ryan veteran, who looks every bit the experienced coordinator she is. As Delaney's office assistant, her primary duty is supervising preparation of the manifest, a receiver's "bible" in which is recorded every shipment and by what method it was delivered. Close at her hand is a public address system microphone which gives her a sonic long arm to track down her boss for quick decisions and important phone calls.

TO her right for ready reference are four pairs of long, horizontal filing boxes containing "open" purchase orders. Another pair of these boxes and 12 cabinets hold "closed" P.O.'s, kept for a year. Since Receiving Reports are largely based upon information appearing on P.O.'s, Carrie and her staff are constantly pouring over the file boxes, checking packing sheets, which show what a recently arrived shipment contains, against original P.O.'s.

Once a shipment has been counted, given a routine check and had its Receiving Report made up, it is ready for Receiving Inspection, another vital preliminary to manufacturing.

The shipment is first classified as either "C" (overhead, non-production supplies), or "A" (production materials). Shipments with an "A" tag must go through inspection, while the "C's", usually office supplies, steel for non-manufacturing purposes, or similar finished goods, are forwarded without extra handling direct to the departments for which they are on order.

"A" materials are further divided into

(Continued on page 18)

WELL RECEIVED

(Continued from page 17)

two categories: "Vendor's Parts" made to a supplier's own blueprint (e. g., engines, propellers, light switches, etc.) for use in a Ryan final assembly job; and "Outside Production Parts" specially made to Ryan or Ryan customer specifications (e. g., components for Pratt & Whitney engines, Convair 240 header flanges, castings for Aerobee Rockets.) For the former group there is a careful inspection assuring quality, but less rigorous than the scrutiny applied to the latter category. In a classification by themselves, are "Furnished Materials", both raw and semi-finished, which are shipped by a customer to Ryan for completion. They receive the same painstaking inspection as "Outside Production Parts".

Presiding over Receiving Inspection is H. V. Bilben, who every morning makes the rounds of his stations beginning with the Precision Stand where dimensions are checked with highly sensitive instruments on such important items as stainless steel rings for the Ryan-built exhaust cones of General Electric jet engines. Extreme care is taken to make certain that blueprint tolerances are met with razor-sharp accuracy.

Thickness measurements are taken on a test stand that accommodates the largest spun aluminum surfaces, like those figuring in the assembly of giant external fuel tanks.

Utilizing a setup that an observer would ordinarily expect to find only at a main production inspection station, Receiving Inspection puts heat-treated metals through tensile tests on Rockwell machines as a hardness check. A magnaflux bench guards against the possibility of carbon- and certain alloy-steels proceeding to production areas with even the smallest cracks or breaks.

Hydraulic units for the Boeing C-97 Stratofreighter and Navion executive plane—tubing, actuating cylinders, selector valves, restrictors, master brake cylinders—are submitted to a bank of hydraulic testing devices to insure perfect performance once the equipment has been forwarded to assembly departments.

Sharing office space with Bilben and his crew is William F. Hein, the Air Force's own inspector, who conducts sample inspections on materials received for use in government orders and double-checks important paper work.

Extruded aluminum, bar stock, tubing and specially-formed large metal sections are transfered directly from railway cars or trucks into the raw stock room, where with the aid of overhead cranes and special handling devices the material is carefully moved for inspection and subsequent storage until the Transportation Department distributes it to waiting presses, lathes, drop hammers, jigs and ovens.

Keenly aware of the importance of the receiving function in the scheme of factory operations, C. A. Stillwagen, Director of Materiel and Contracts, together with E. R. Wiles, General Superintendent of Receiving, Shipping & Transportation, and Chief Inspector A. S. Billings form a familiar team as they confer at the unloading dock or in the raw stock room, ever after better ways to get the job done. They've made Space, Speed and Precision the keynotes of their program.

ANOTHER valuable quality of the Receiving organization is a flexibility that has permitted rapid acceleration of activity over the past year to the point where, as in last November, more than 3,000 shipments are received, inspected and distributed monthly. In one day of November, 199 shipments were delivered by train, truck, plane and automobile. And, of course, each shipment can vary from 1 to 100 individual boxes, crates or barrels.

Methods Engineering Chief E. F. Mellinger and his top facilities planners, J. R. Ferguson and C. A. Lorenz, were turned loose on the Receiving setup six months ago with orders to do whatever layout revamping would be necessary to supply the capacity to meet anticipated new peak workloads. Typical of their high-score success: Biggest trucks and semi's can turn full around in the main unloading area, virtually eliminating traffic jams among delivering vehicles; jobs formerly taking 30 minutes are now polished off in four or five.

To find examples of modern industrial efficiency it isn't necessary to search out mass production assembly lines. A good look at the real beginning of things in a wide-awake Receiving Department whose functions were planned with forethought is amply rewarding.

—Robert F. Smith.

Department of Defense Photo

ME, JOE U. N. NUMBER ONE BOY, NOW!

Somewhere in Korea this spic and span little fellow eagerly examining the cabin of a U. S. Air Force Ryan Navion L-17B at an advanced air strip, is a true product of the United Nations. Adopted in South Korea by a clearing company of the 15th Medical Battalion of the First Cavalry Division, he is known simply as "Joe".

Joe's mother and three brothers and sisters were executed when the Communists overran Yongdok, in South Korea. He and his father were adopted by the Americans when they first drove the Communists north.

Joe now looks sharp in a battle jacket cut down from the coat of a wounded Australian officer. His pants came gratis the British Army, slightly altered a dozen or so sizes. "Me U. N. Number One Boy, now", says Joe.

NEW LOOK IN ENGINEERING

(Continued from page 12)

until recently served in the Bureau of Aeronautics' Maintenance Division as Head of the Power Plants and Field Service Branches. Twenty-two years in aviation, White was with Wright Aeronautical Company for 12 years supervising Field Engineering, then was Vice President-Treasurer of Wright Aero, Ltd., before going on wartime active duty. While in the Navy, White was in charge of Maintenance at an advance base in the South Pacific.

Development Projects are headed by **Herman L. Braasch** who has been with Ryan in key engineering posts for the past four years. Prior to that he was with Consolidated Vultee at Fort Worth where his principal assignment was as structures engineer on the B-36. Among projects under Braasch's supervision are the Ryan XQ-2 jet target plane; guided missile, jet engine and exhaust systems research; engineering laboratory, and aerodynamics and structures groups.

In addition to the refurbished and enlarged main engineering and executive room shown in the illustration are separate sections for Preliminary Design, Electronics Laboratory, Engineering Laboratory and Conference Rooms. Engineering quarters, including facilities for instrumentation and data reduction, with assigned Ryan engineering and flight test personnel, are also maintained at Holloman Air Force Base, Alamogordo, New Mexico, and at Edwards Air Force Base, Muroc, California.

Presentation of 10-year service pins to 88 veteran Ryan employees was the occasion for the broad grin T. Claude Ryan, President, wore throughout the evening. Fred B. Churchill of Airplane Inspection is on the receiving end of a hearty handshake.

First to receive a Ryan 25-year service pin was President T. Claude Ryan. Earl D. Prudden, Vice President, made award.

Ryan Old Timers' Rally

October 3, 1942, on the Twentieth Anniversary of the Ryan organization, 72 veteran employees were honored by the presentation of 5-year Service Pins. That began a significant Ryan tradition.

The majority of those present on that occasion sat down for a reunion during the Christmas holidays just passed, this time joined by 200 fellow workers, all now qualified as Ryan 10-year veterans.

Following the banquet, 88 employees were presented diamond-studded 10-year service pins by T. Claude Ryan, President, and one, W. M. Cattrell, of the Engineering Laboratory, received his 15-year service pin. Somewhat belatedly it was discovered that Claude Ryan had never received a 25-year service pin, so Vice President Earl D. Prudden, made the quarter-century service award. Actually it had been earned three years, prior, for it was in the fall of 1922 that Ryan started his commercial aviation business in San Diego.

High point of the evening's program which brought everyone to his feet in a standing ovation, followed the entertainment. A. S. "Bill" Billings, Chief Inspector, who had just received his

(Continued on page 24)

More than 225 Ryan employees with 10 years or more service were honored at an Old Timers Night in the Terrace Room of Manor Hotel.

FLIGHT FOR LIFE

(Continued from page 1)

asthma and some heart cases also are difficult to handle without pressurized equipment.

The high-flying Boeing Stratofreighters require strong, resistant hulls to withstand the cabin pressure necessary for high altitude operation. To maintain a comfortable pressure within the plane at all times, the aluminum body of the C-97 must be relatively "leak proof."

Insuring the structural strength and a minimum leakage of the C-97's rear fuselage section is the problem of Ryan Aeronautical Company production workers and the pressure testing group at the plant's Boeing Assembly Department. The plant's Metal Products Division also turns out the C-97's exhaust systems.

The story of air evacuation begins the moment a soldier or marine is wounded in front line action. A man is shot. A mortar blast fells him. A grenade rolls into his foxhole, explodes.

He may be removed by a MATS Air Rescue Service helicopter or reconnaissance plane to a rear echelon hospital. In another instance he may be airlifted direct to one of three hospitals in Japan: The Osaka Army Hospital at Itami Air Field; Tokyo Army Hospital; or the 361st Station Hospital—also in Tokyo. From these hospitals the patients are taken to MATS Haneda Air Base or Itami Air Field where they will be loaded into the cavernous upper deck of the bulging C-97's.

Patients scheduled to leave on the Stratofreighter flight are medically evaluated to see if they can be moved. Then determination is made on the placement of patients—down to the exact litter. Those with contagious diseases are placed toward the front of the cabin; fracture cases are placed with casts on the aisle side of the litter; heavy patients are located in lower litters; mental cases are grouped at the rear of the cabin.

Space is limited aboard the planes. Stretchers are hung from canvas loops in tiers of four. Between the two rows of stretchers running the length of the cabin is a narrow passage—just wide enough for the flight nurse and the two medical corpsmen to go about straightening blankets, changing dressings, and serving hot food.

Litter patients are stacked four deep with only a few inches separating a man's face from the litter above. Although at each landing doctors come aboard, the nurses are fully responsible for their patients' welfare en route.

The giant Stratofreighters take off from Haneda Air Base or Itami Air Field near Tokyo after obtaining the latest weather information from MATS Air Weather Service. Haneda is the eastern terminus of the Pacific Air-lift. With only a brief stop at Midway or Wake to refuel and a rest stop at Honolulu's Hickam Air Force Base, they head for home across the vast stretches of the Pacific to Travis Air Force Base. Some go on to Kelly Air Force Base, San Antonio, Texas.

While casualties rest at Travis, messages click across MATS Airways and Air Communications Service's teletype system that links all Air Force bases in the U. S. The Surgeon General in Washington, D. C., assigns each man to the Army or Navy hospital nearest his home whenever possible. Simultaneously, air evacuation detachments at air bases nearest those hospitals are notified when men are coming. Other messages alert the hospitals.

Forty-eight hours is the ideal time for a patient to remain at Travis or Kelly before transfer to his assigned hospital. Occasionally, the seriousness of a case may prolong the stay from ten days to two weeks; at other times, patients may lay over but a few hours.

At the final destination the hospital's first concern is the immediate comfort of every new arrival. Casts are changed. No matter what time of night, surgery, when necessary, is performed. Dressings are freshened. Hot meals are served.

With funds provided by the Red Cross, the men may telephone their wives or parents. They're home and in good hands.

Ryan Vice President Earl D. Prudden beholds in amazement the 12,000 individual pieces of currency and coin dumped on his desk recently by O. C. "Chet" Hall of Grand Rapids, Michigan, in payment for a 1951 Super Navion. Piled high before the Ryan executive peering over them are two tightly-bound stacks each of 4,000 one-dollar bills.

Hall, whose Northern Air Service organization is Navion distributor for Michigan, needed two helpers to carry in the currency and a suitcase full of silver dollars to make this first recorded "all-in-cash" purchase of a Navion. The silver alone weighed 60 pounds. Hall had planned to pay all in silver but the 720-pound weight of the coin caused a last-minute shift of $11,000 to dollar bills.

AIR evacuation was conceived not long after the Wright brothers invented the airplane in 1903. Army medical history credits Maj. Nelson E. Driver, Marine Corps, and Capt. William C. Ocker, U. S. Air Service, with successful air movement of the first patients in the U. S. In 1918 Driver and Ocker converted a JN-4 airplane into an air ambulance at Gerstner Field, La., and used it on several missions.

A French doctor, however, must be credited for inventing the first airplane ambulance ever used in actual warfare. This was on the Amiens front in World War I. During World War II the Army Air Force moved approximately 1,360,000 patients by air.

As late as October 1949, many military medical patients were still being moved by hospital ships and trains. On October 1, 1949, the Secretary of Defense directed that world-wide air transportation of military medical patients be taken over by MATS.

Conservation of critically scarce medical personnel, consolidation of medical facilities, savings of en route and duty time lost, and the morale factor of rapid transportation to specialized base hospitals within the U. S. were points advanced in favor of changing from surface transportation. Later, critical bed shortages in forward and theater areas made air evacuation almost mandatory.

Air evacuation also solves the problem of caring for non-effectives in battle areas. This has perplexed military combat commanders since the day of spear and shield.

The advantages of air evacuation are many. The morale factor is unquestioned. Future logistical and tactical situations call for mass air evacuation of our ill and wounded.

There is no alternative. Military medicine of necessity has sprouted wings. Aviation transport and military medicine —two modern miracles—have permanently joined hands to bridge the areas to bring hope and life to the military ill and wounded—worldwide.

INVISIBLE SEAM

(Continued from page 3)

are several theories concerning the phenomenon which occurs. Ryan metallurgists incline toward the belief that when a deformation is brought about in a hot metal, the crystals break up, spontaneously grow together again because of the high temperature present and join with other crystals that formerly belonged to other parts. Another explanation propounded is that the atomic lattices unite with each other when sufficiently hot and pressed together.

The bonding action produced by electric resistance welding occurs while the metals are within the plastic range—below their melting point. This is the primary difference between this type of welding and fusion welding and accounts for the desirable absence of carbon and oxidation from the weld area. In addition, the heat from electric resistance welding can be produced quickly and in a concentrated zone so that carbide precipitation, often encountered in welding corrosion-resistant steels, is avoided.

Formerly considered suitable only for secondary structures, this welding process is now widely utilized in building a myriad of highly-stressed components of major importance in the aircraft field. This acceptance is directly attributable to two developments: vastly improved machines with electronic controls and successful research programs which manufacturers, such as Ryan, have conducted.

Ryan production makes generous use of all types of electric resistance welding including spot, seam, rolled-spot and spot-tacking. The difference between these methods is mostly one of timing. All involve three stages consisting of "squeeze time", "current time" and "hold time." "Squeeze time" is that interval when the metals are pressed together for good contact, preceding current flow. "Current time" is the electronically-controlled period while the current flows between the electrodes to produce the welding heat. "Hold time" is the pause during which the electrodes compress and forge the plastic metal while it is cooling and quickly draw off the heat to prevent formation of a cavity in the weld nugget.

Seamwelding is performed on specially-designed machines which make a series of over-lapping spotwelds to form a strong, gas-tight seam. One of the most dramatic examples of the efficiency of this method is illustrated by the design and successful fabrication of a huge external wing tank which Ryan is building in substantial quantity. Probably the largest fuel container ever designed for aircraft, this complete tank is assembled from seamwelded sections into a gas-tight reservoir without the aid of sealing compounds. Its smooth, streamlined exterior is particularly clean from an aerodynamic standpoint because the conventional rivets have been replaced by headless, invisible nuggets of completely fused metal.

Ryan is using spot and rolled-spot welding to build floor beams for the huge Boeing C-97 Stratofreighter — a cargo plane which contains two loading bays and ramps large enough to accept motor-driven vehicles. These important structural members are made from 24ST and 75ST aluminum material. The rolled-spot welding is accomplished by the use of rotary electrodes which make regularly-spaced spotwelds at designated spacings. Operating automatically and continuously, these precision machines perform their work with speed and robot-like uniformity. By the use of spot-welding it is possible to fabricate the C-97 floor beams from sheet stock instead of extrusions.

Scrupulous care must be exercised to clean the aluminum assemblies prior to spot-welding because any soil, even one fingerprint, can cause defective spot-welding. All parts are immersed in hot alkaline baths, rinsed, immersed in etchant tanks and rinsed again before spot-welding. Operators must handle the parts with clean white cotton gloves. Parts must be spotwelded within 24 hours after cleaning to avoid the formation of an air oxide film which causes increases in electrical resistance.

Electric resistance welding is well suited for use with the corrosion-resistant steels because the normal cooling of the spotweld is similar to quenching. The weld nugget is a dead-soft annealed union and is often tougher and more ductile than the surrounding metal. Under severe loads individual spotwelds

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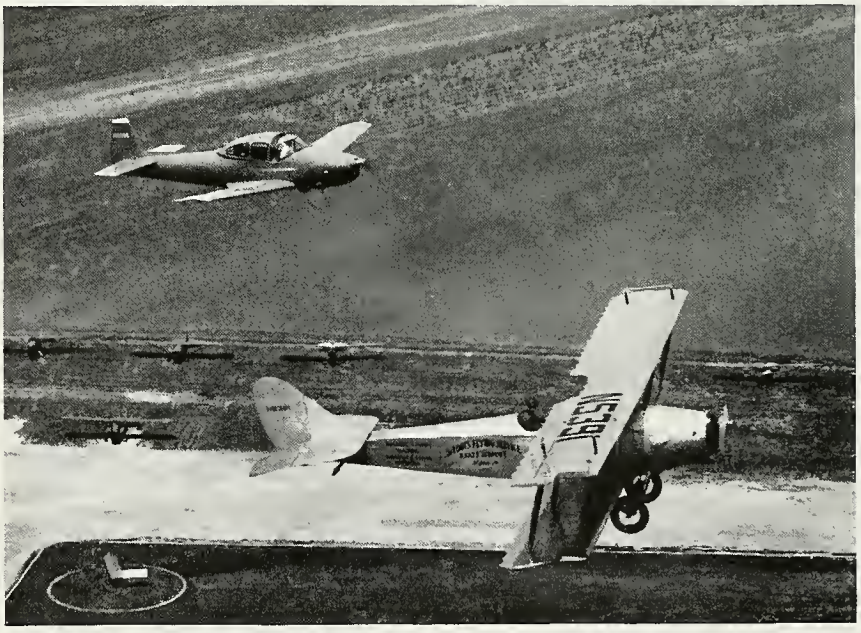


35-YEAR WING SPAN

A 35-year-old Curtiss Jenny biplane came out of retirement recently after spending the last quarter century alone and forgotten in a barn on a farm near Hammond, Indiana, to take the air again beside a modern Ryan Navion.

For years, Arch McEwen, president of St. Louis Flying Service, Ryan Navion distributor at Kratz Field, had heard reports of a 1915 Curtiss Jenny stored in a barn in Indiana. After two years' search, McEwen—who has a yen for collecting memorabilia aeronautica—finally located the Jenny, paid $100 for the remains and $100 for hauling them to St. Louis.

The wood structure was all rotted out, as was the fabric, and McEwen completely rebuilt the Jenny to its original configuration. The plane had a Hisso 150 h.p. engine, but it was completely rusted and no parts were available, so a 185 h.p. Ranger engine was installed. McEwen was also able to find some World War I wheels to replace those which had completely deteriorated on the original plane.

Pilots around the St. Louis area these days are occasionally startled to see McEwen's 1915 Jenny sharing the sky with them. St. Louis Flying Service executives use the old biplane for advertising and promotion at air shows and exhibits throughout the Middle West.

INVISIBLE SEAM

(Continued from page 21)

will stretch, long before they break, shifting part of the load to other spotwelds in the weld pattern and all of the welds will carry the same load. With stainless steel it is possible to secure joint efficiencies in excess of 90 percent as compared with an average of 60 per cent for riveted joints.

Ryan spotwelds and seamwelds transition liners, combustion chambers, inner and outer cones and tailpipes for the General Electric J-47 jet engines which power the mammoth Boeing B-47 and Convair B-36 bombers. These parts must withstand high stresses and elevated operating temperatures. They are vital assemblies. The failure of these welds could cause critical damage to the power plant with consequent loss of aircraft and personnel. Use of electric resistance welding in these jet components is a high tribute to its modern effectiveness.

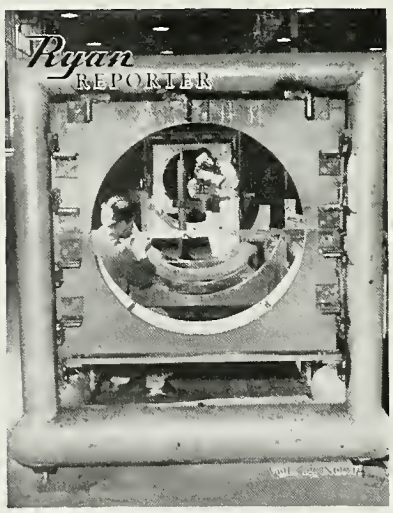
AN intricate example of seamwelding profficiency is the heat exchanger which Ryan manufactures for Air Research. Consisting of a group of long, flat tubes arranged to form a cylinder, this unit is used to transfer heat energy from exhaust gases to air for warming cabins and carburetors. Entirely seamwelded, each unit has over 100 feet of this type of welding in its composition. To serve its purpose, it must be absolutely gas-tight and occupy as compact a package as possible.

It is usual procedure to seamweld many attaching fittings for the exhaust collector rings Ryan builds for the Boeing B-50 and C-97 airplanes. Also, Ryan employs this technique for making exhaust systems for the Continental 1790 engine which powers the M-46 General Patton tank. In this application, the slip joints for the manifold are first spot-tacked and then seamwelded. They must be fitted to a close tolerance of .005" in one direction and zero tolerance in the other. These minute clearances can be maintained by seamwelding the joints because this process affects only a small area and the amount of heat generated is reduced by welding under water.

To insure strong, efficient spotwelds, Ryan maintains a scheduled and frequent supervision over machine performance. Once every hour all machines are checked by roving inspectors who make a shear pull-test and Macro-test of samples. The machine operator is required to make a peel-test each half hour of machine operation. A permanent record of these tests, together with the machine settings used, is kept for the scrutiny of inspectors so that a running record of each machine's output is available. This type of control is particularly essential to good spotwelding because spotwelds do not lend themselves to the ordinary visual inspection which is satisfactory with other types of welding.

There appears to be no valid reason why electric resistance welding cannot be extended to perform more and more of the necessary jobs of aircraft manufacturing. Its quick, clean facility for joining metals is peculiarly advantageous to the weight-conscious aircraft industry. As greater knowledge of metallurgy is acquired and increased experience with stressed structures is accumulated, spotwelding will assume larger responsibilities. Ryan engineers are alert to the possibilities which spotwelding present and are continuing to expand their design efforts in order to capitalize upon these time-saving and cost-cutting opportunities.

—William P. Brotherton



ON THE COVER

An assembly jig to be used in building Ryan-designed external fuel tanks takes shape in the Tool Manufacturing Department. Jig builders Robert Overton and Richard Hoack take accurate measurements to assure precision in the final manufactured article.

The jigs will hold the huge wing tank cylinders accurately in place while external strut fittings are attached during the assembly operations.

BRAKES FOR THE B-36

(Continued from page 7)

structure, starting at the trailing edge. Then these components are removed from the flaps and all of the rivet holes are dimpled in a coin-dimpling machine to accept the counter-sunk rivets which are to be set in this flush-riveted structure. Ryan is installing heavier skins throughout the flap and more stringers than were formerly employed in the design.

One of the difficult phases of the work is due to the necessity of installing hundreds of Intercostals and clips which tie the stringers, skins and ribs together and must be precisely aligned in three planes before riveting. All of the Intercostals must be countersunk to allow room for the dimpled skins.

The final installation of the upper skins is accomplished in accurate manufacturing steel jigs so that perfect dimensions may be attained. Here, too, the flap hinge points and actuating arms are carefully checked. The lower surface skins are put in place in the clean-up area of the assembly line and then the flaps are strapped in a specially designed turn-over jig and rotated and vibrated. This causes all metal particles and extraneous materials from the fabrication work to fall to the bottom where powerful vacuum cleaners remove it so that it presents no hazards in flight.

The flap interiors are sprayed with zinc chromate primer, to protect them from any corrosion and the access door frames and doors are installed. New, molded sponge rubber seals are glued to the flap edges to seal them aerodynamically from the adjacent engine nacelles. Last components to be added are the small electric motors and harnesses which actuate the flap at the pilot's command. Located in the center of each flap, these motors turn two shafts running to each flap side, where gears engage the airplane wing. Their movement causes the flap to move out and down from the wing and to provide a powerful deceleration to the B-36's tremendous momentum.

After the final inspection, the modified flaps are polished, sprayed with plastic envelope and shipped to Convair. Ryan developed the polishing compound, which is superior to commercial compound available, because it leaves absolutely no corrosive after-effect.

Air Force and Convair Inspectors, working at the Ryan plant, give the flaps final approval so that they can be immediately mated with their respective aircraft upon arrival at Convair without the need for receiving inspection operations.

PLANT TOUR

Unfortunately we don't have the opportunity to show many readers through the Ryan factory, but we can ask you to join us in this column while we go through the plant and meet some of the people who help make Ryan a better place to work.

ON STAGE. When the multi-lingual operetta, "A Gypsy Camp", had its first San Diego presentation this winter, **Carlos Alvarado-Prieto** of Punch Press sang a leading role demanding a mastery of Italian, Spanish and English. This wasn't too imposing a challenge to Carlos, however, who has been exercising his rich baritone since his boyhood in San Turce, Puerto, Rico, and sings fluently in Russian, French, German and Latin, too. Operatic and oratorio work at Milwaukee's Wisconsin Conservatory preceded his coming to Ryan in 1948, where, while manning a punch press, he continues vocal training with local teachers.

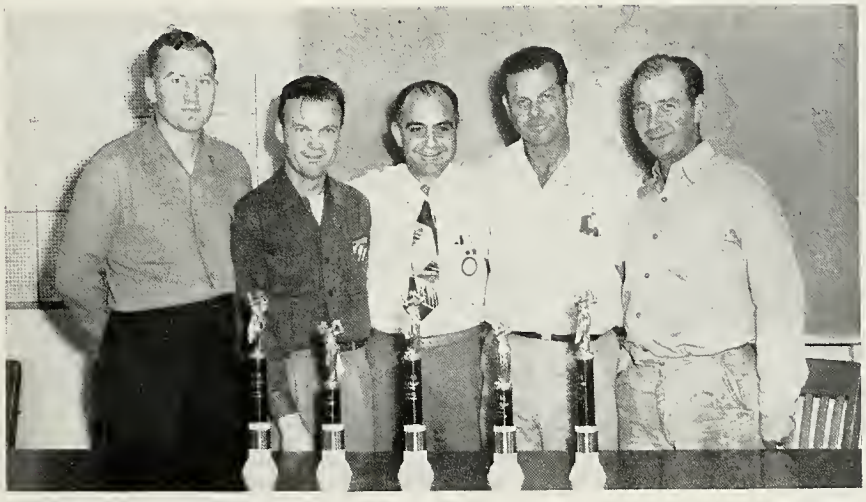
ROSES. Staunchest Golden Bear rooters at the Rose Bowl classic were **Athena** and **Joyce Marinos** who temporarily left their places in Production Control and Shipping in favor of New Year's Day fifty-yard line seats to cheer on brother **Jim Marinos,** California's first string quarterback. The girls have been bursting with pride all season long as their brother chalked up his most successful year with the Cal gridders.

OPERATION MAJOR. Promotion during combat has come to **Bill Holt,** former Ryan test pilot, who recently received his major's commission with the U. S. Air Force in Korea. Bill flies jets attached to the 80th Fighter-Bomber Squadron.

DOUBLEHEADER. The Inspection Department is sporting one of the Company's most unusual attendance records. Recently both Chief Inspector **Arthur S. Billings** and Assistant Chief **Larry Martin** each completed ten years of Ryan service without a single day's absence.

NEW GOLF CHAMPS. Match play for the 1950 Championships brought out Ryan Golf Club members in force recently at Mission Valley and Rancho Santa Fe courses. Winners and runners-up in the Annual Tourney were **Ray Campbell** and **Erv Marlatt** in the first flight; **Bill Hudson** and **G. E. Barton** in the second flight; **Jim Whitten** and **Ernie Simonson** in the third flight. Newly elected officers include **Darwin Whetstine,** President; **Ray Campbell,** Vice President; **Bob Jamison,** Secretary; and **Mel Curry,** Treasurer.

DIAMOND DUST. The St. Louis Cardinals line-up will include Big League 2nd baseman **Solly Hemus,** Dispatching, when next season rolls around. Solly heads an impressive list of AAA-and-better ball stars now on the Ryan employee roster. Pitchers **Al Olsen** of the night shift and Receiving Inspector **Bob Kerrigan** are favorites of the hometown San Diego Padres, and **Del Ballinger,** Sheet Metal, holds down the catcher's post for Indianapolis in the American Association. All but Kerrigan, who's a newcomer, are veteran Ryan employees.



Ryan Golf Club champions with their trophies (l. to r.): Jim Whitten, Ernie Simonson, Bill Hudson, Erv Marlatt, Ray Campbell. Champ G. E. Barton not in picture.

AN OSCAR FOR US. The Community Chest "Oscar", a smart little trophy modeled after the famous movie star awards, was presented to Ryan employees recently for their outstanding role in the Chest's campaign in San Diego. In contributing a total of $8,135 and showing the year's biggest contribution increase per capita, Ryan men and women were the only employees of any San Diego business firm to earn an "Oscar" in 1950.

First stop for Oscar on a personal appearance tour among departments which turned in top performances in the plant campaign was Engineering (had highest departmental total: $800), where **Betty Yost, Frances Thurmond** and **Ruth Alford** welcomed him for a week's visit.

APPRECIATION. The interest which Ryan employees take in their fellowworkers in time of need is well known to all who have been with the company any length of time. So others outside the Ryan organization may also get some insight into this spirit of mutual regard, the editors break a rule of not publishing personal notices in reprinting a portion of a letter recently rereceived from Mrs. George E. Gray and family following the death of her husband, **George Gray,** who had worked for Ryan the past two years in the Airplane Inspection Department.

"I am most anxious to have Ryan employees know just how much we appreciated the many kind and thoughtful expressions of sympathy. The capable assistance given in the many matters that had to be taken care of was beyond measure. The generosity of the Ryan donors in repaying the Blood Bank for transfusions needed was most appreciated.

"It is with regret that I noted the newspaper failed to state that my husband was an employee at Ryan, particularly in view of the fact that his relations with the company were always the best. Mr. Gray was always very happy in his work at Ryan."

FLYING PRESIDENT

"Plane campaigns" are as popular in Latin American elections as in the U. S., reports Woldemar Bastos (left), partner in Miller, Medeiros & Bastos, Ryan Navion distributor in Montevideo, Uruguay. During the recent Uruguoyan presidential race, Bastos flew the successful candidate, Sr. Andres Martinez Trueba, about the country extensively in a Navion for his personal appearances. They are shown above just before taking off on a trip into the interior.

Recent U. S. campaigns were sparked by similar Navion political stints. Two interesting examples were South Carolina Governor Strom Thurmond's travels in the Navion owned by W. Perry Smith of Columbia, S. C., and U. S. Senator Henry Dworshak's reliance on Navion-pilot Kenneth Self, Twin Falls, Idaho, for keeping speaking dates scheduled all over the broad and mountainous state of Idaho.

State Representative and Navion owner C. V. Lisle of Clarinda, Iowa, went everybody one better with weekly commuting flights to sessions of the Iowa Legislature in Des Moines.

OLD TIMERS' RALLY

(Continued from page 19)

10-year pin, acted as spokesman for the nearly 250 veteran employees in attendance in presenting a beautiful watch to Claude Ryan inscribed "From His Old Timers."

During the reminiscing which always goes with such occasions some statistical-minded guest calculated that the accumulated experience with the Ryan organization of those present would turn the clock back some 2850 years to 900 B. C.

Seated at the head table, in the order of their seniority, were 11 of the 12 employees with more than 15 years service: *T. Claude Ryan,* President (28); *Earl D. Prudden,* Vice President (22); *H. J. vanderLinde,* Airplane Production Superintendent (21); *Walter O. Locke,* Assistant to the President (19); *Melvin E. Thompson,* Estimator (18); *Will Vandermeer,* Engineering Laboratory Supervisor (17); *M. W. Kelley,* Night Superintendent (16); *Walter K. Balch,* Airplane Service Manager (15); *Carl F. Nesbitt,* Airplane Mechanic (15); *Edward A. Oberbauer,* Assistant Foreman, Navion Airplane Assembly (15); and *W. M. Cattrell,* Engineering Laboratory (15). On a business trip as he so frequently is, and unable to attend, was *Sam C. Breder,* Head of Metal Products Customer Service, with nearly 16 years service, who stands tenth in point of service.

CHAMP BUSINESS FLIER CHOSEN

Logging an average of four hours of company flying every business day in his firm's Super Navion for the entire month of November—when travel is usually seasonally off because of weather—George S. Patterson of the John L. Hudson Company, Grand Island, Nebraska, has earned top honors for the Flying Businessman Contest's opening month. The Hudson Company is an engineering and construction organization specializing in the erection of pre-fabricated buildings.

Ryan Vice-President Earl D. Prudden presented an engraved bronze plaque emblematic of the FLYING BUSINESSMAN OF-THE-MONTH selection to Patterson in ceremonies held at the factory. Patterson topped a large group of entrants hailing from all over the United States to win the first month's prize. As Project Manager for the Hudson Company, he did most of his flying between the 54 locations around Grand Island where his company has spent a busy fall season building grain storage bins.

November's contest runners-up were Howard T. Martin, rancher from El Paso, Texas; Robert B. Reed, publisher of San Angelo, Texas; and the Superior Oil Company, Houston, Texas.

Current competition indicates an even larger number of entrants are vying for December and January awards. Navion owners who have not yet submitted an entry are invited to do so, with the reminder that in addition to each monthly plaque there are silver plaques for owners with the highest hour-totals during quarterly three-month periods, and an annual gold trophy for the FLYING BUSINESSMAN OF-THE-YEAR. Though he is eligible for one of the quarterly plaques or the grand prize trophy, by virtue of his present victory Patterson may not win ent victory, Patterson may not win

Entry blanks are available at either the Ryan Aeronautical Company or Ryan Navion distributors and dealers. Once a Navion owner has entered the competition, future entry blanks are automatically supplied throughout the year.

ALLISON VISITORS

Latest techniques in manufacturing stainless steel components for jet engines were studied by top executives and engineers of the Allison Division of General Motors Corp. on the occasion of a recent visit to the Ryan Aeronautical Company plant.

Heading the porty of experts from the Indianapolis headquarters of Allison was E. B. Newill, vice president of General Motors, and general manager of the Allison Division, who had just been elected Chairman of the Board of Governors of the Aircraft Industries Association. Also in the group were Ronald M. Hazen, Allison director of Engineering, J. B. Wheatley and G. R. Shields.

The tour of the Ryan plant was conducted by T. Cloude Ryan, president; Bert Bowling, producting manager; Sam C. Breder, head of Customer Service; and W. T. Immenschuh, executive engineer.

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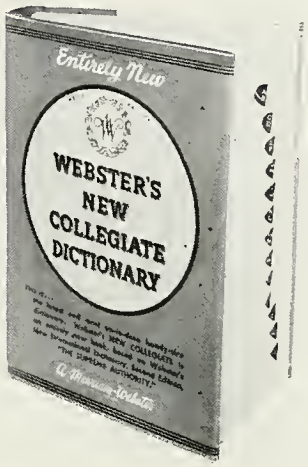
A



B

COMMUNISM (WEBSTER'S DEFINITION)

A doctrine and program based upon revolutionary Marxian socialism as developed by N. Lenin and the Bolshevik party, which interprets history as a relentless class war eventually to result everywhere in the victory of the proletariat and establishment of the dictatorship of the proletariat, and which calls for REGULATION OF ALL SOCIAL, ECONOMIC, AND CULTURAL ACTIVITIES THROUGH THE AGENCY OF A SINGLE AUTHORITARIAN PARTY as the leader of the proletariat in all countries so as to achieve its ultimate objectives, a classless society and establishment of a world union of socialist Soviet Republices.

DEMOCRACY (WEBSTER'S DEFINITION)

Government by the people: government in which the supreme power is retained by the people and exercised either directly, or indirectly through a system of representation.

RYAN AERONAUTICAL COMPANY
LINDBERGH FIELD
SAN DIEGO 12, CALIFORNIA

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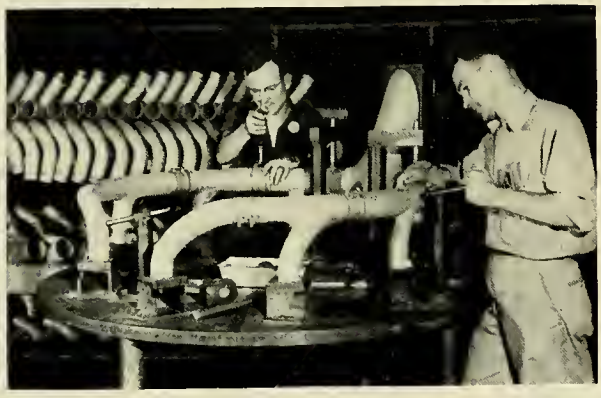
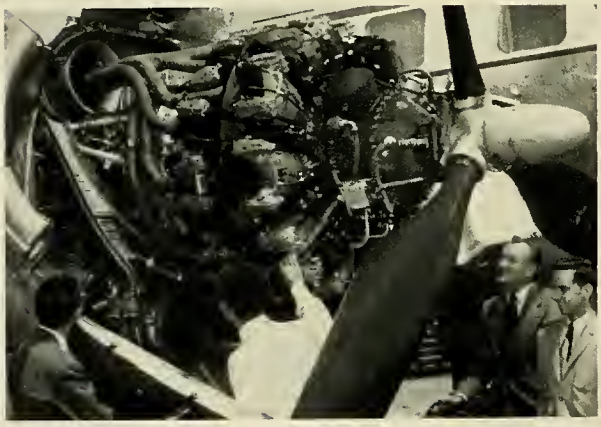
57 80

EXHAUST SYSTEMS SERVICE...
..."nothing short of a miracle"

"Twenty-four hour service . . . in fabricating and delivering these exhaust systems is NOTHING SHORT OF A MIRACLE." That's how Ryan's on-time performance was described in an unsolicited statement by an engineering executive of a leading aviation company. Actually, it's the logical result of Ryan's unique 3-step service.





1. ENGINEERING AND DESIGN CONSULTATION

Call on Ryan for technical assistance *in the design stage* of your project. It will result in weight saving, assure superior performance and service, and save precious engineering time. Our technical people are immediately available *anywhere* to service the Air Force, Navy and all airframe, engine and guided missile manufacturers.

2. SUPERIOR PRODUCTION EXPERIENCE

Ryan has been foremost in making the design and production of exhaust systems a specialty in itself and is today still the only manufacturer with the "know-how" which comes from also designing and building complete aircraft. Ryan Metal Products are standard on many of America's most successful commercial military planes.

3. FOLLOW-THROUGH SERVICE

So that Ryan manifolds may give the fine service of which they are capable, our service department has been staffed with specially trained personnel. These men are always available to Ryan customers. Take full advantage of Ryan's *engineering* leadership, advanced *production* techniques, and *service* experience in high-temperature metallurgy.

RYAN Metal Products

DIVISION OF RYAN AERONAUTICAL COMPANY • LINDBERGH FIELD • SAN DIEGO, CALIFORNIA

Ryan REPORTER

VOL. 12, NO. 2

Ceramics for the Hot Spots

Adapting an ancient art to modern aircraft

CERAMICS, an art thousands of years old, associated with the aesthetic expressions of countless civilizations, is beginning to play a vital, industrial role in modern high-performance aircraft.

During World War II, when metallurgists were confronted with the need for saving such strategic materials as high grade, heat-resistant alloy steels, ceramic coatings were applied to increase thermal efficiency while using low carbon steels.

At Ryan Aeronautical Company, pioneering work in the ceramics field was performed when portions of more than 500 complete exhaust systems for the Douglas A-20 attack bomber were given thick porcelain enamel coatings. These were applied on SAE 1020, a low carbon steel used in manifolds because of a critical shortage of stainless steel.

Today the use of ceramics has taken long strides as Ryan metallurgists, designers and service engineers continue their development studies. Stresses have gained in magnitude and operating temperatures of piston-engine exhaust systems have increased considerably since World War II. Engines generating 3000 h.p. and more, nearly twice that of the biggest power plants in regular use

Complex exhaust system built by Ryan for Boeing 377 Stratocruiser is examined by Wilson Hubbell, chief metallurgist, and C. L. Foushee, Jr., service manager. A ceramic coating extends life of the equipment.

in the last conflict, are not uncommon. The need for improving heat resistance and checking corrosion from the exhaust gases has increased sharply.

For several months, tests of "header" sections of Ryan exhaust systems with thin ceramic coatings of .001" to .003" have been conducted under regular service conditions in a Pan American World Airways' Boeing 377 Stratocruiser operating on transpacific runs.

These tests have been the subject of innumerable conferences in Seattle and San Francisco between C. L. Foushee, Jr., Ryan service manager, T. C. Hacker, manifold project engineer, and Boeing and Pan-American technicians.

After 650 hours service, close examination was made in Ryan's engineering laboratory of the comparative effects of high temperature on headers ceramic coated inside and out, headers coated only on the inside, headers with no coating, and headers fabricated of other heat- and corrosion-resistant alloys.

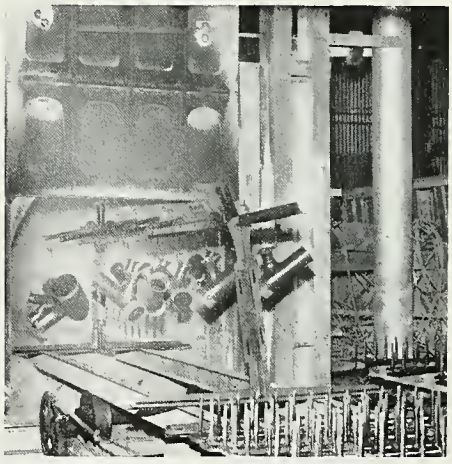
The results have been considered encouraging enough to merit production of "B" and "C" row cylinder header assemblies with ceramic coating for the Boeing 377's. Meanwhile, service tests are continuing, and inspection is under way on ceramic-coated headers and non-coated control headers which have been in use more than 1200 hours on the same plane.

The header with ceramic coating inside and outside, after 1234 hours, was revealed to be essentially the same as when examined at 650 hours. It was determined by thickness measurements and spectrographic analysis that the ceramic coating still is in evidence on both the inner and outer surfaces. This indicates that the ceramic has offered complete protection for that period of time.

Additional tests are being conducted on an American Airlines Convair 240, in which the entire exhaust systems of both engines have ceramic coatings, and on a Pan American World Airways Boe-

(Continued on page 24)

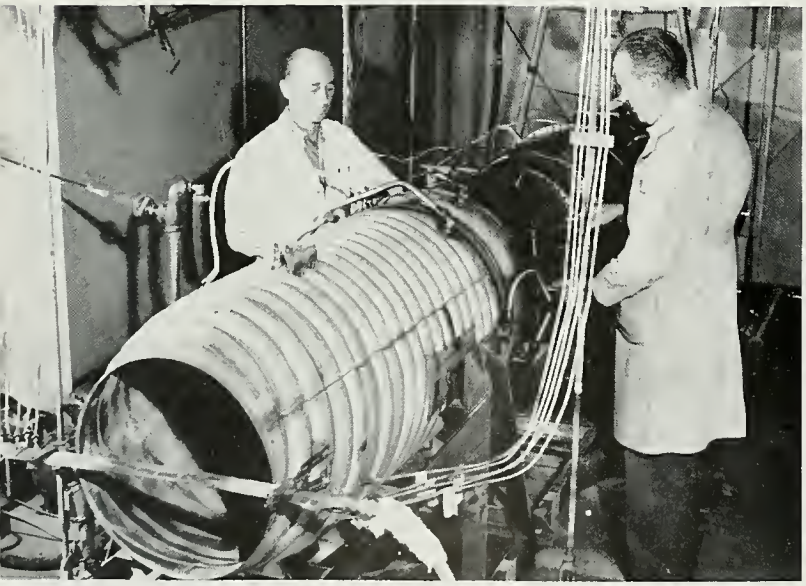
"Header" sections are carefully dipped and drained to provide complete coverage of both the interior and exterior surfaces.



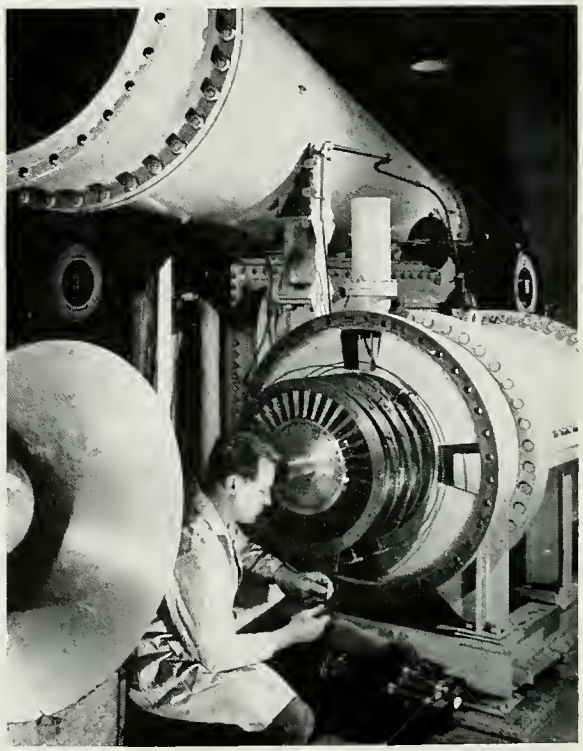
"Fired" parts are removed from furnace, where they are hung from heavy hooks and frames while 1850° F. heat is held.

Above: Conveyor carries "header" sections to firing in special, high-temperature V-bottom furnace, 12 feet long, 5 feet wide and 4 feet high. Firing time is approximately 12 minutes. Right: Fired parts are thoroughly inspected for fullest coverage.

Before an engine model is qualified for production, it must spend many hundreds of gruelling hours in an engine test cell like the one above. A Westinghouse jet engine can be seen through the bullet-proof window of the control room.



Above: Ryan after-burner is checked in jet engine test cell. This was one of many configurations tested and developed by Ryan engineers in intensive research into re-heat thrust augmentation. Westinghouse J-34 engine was used for test work.



Right: New compressor designs are tested by Westinghouse. Company steam turbine know-know helped develop gas turbines.

NAVY TURBOJET PIONEER

Westinghouse Electric Corp. helps set the pace in a new industry which has achieved maturity in a brief 10 years

A FEW short years ago the words jet propulsion and turbojet engine were unknown to most people. In just ten years a new industry has been born and is rapidly achieving maturity. Engines which today provide power for the world's best military aircraft tomorrow will also propel commercial airliners swiftly and safely to their destinations around the globe.

Westinghouse Electric Corp. has been an active participant in this new industry from the very beginning. To date the Aviation Gas Turbine Division has designed, developed and built five distinct engine models. The performance of the latest models, the J40 and J46, is still veiled in military security regulations but these engines will be among the most advanced and powerful turbojet engines in the world.

Westinghouse entered the field of jet propulsion in 1941 at the request of the U. S. Navy Bureau of Aeronautics to develop this basically new type of aircraft engine. The work was to be done without reference to the extensive work already accomplished by various European designers. The Navy carefully excluded Westinghouse engineers from contact with these earlier developments because it was felt that an entirely fresh approach was needed so that the new jet engine might gain full advantage of the expetience and ingenuity of American turbine engineers.

There was a good reason why the Navy entrusted this vital project to a steam turbine builder for in the factories and engineering offices of a turbine manufacturer could be found the particular combination of technical skills and know-how that were needed to evolve the gas turbine. Thus Westinghouse started its development with the background of high rotating speeds and high temperature, acquired in the field of steam turbine manufacturing, and with the inventiveness of their development and research engineers.

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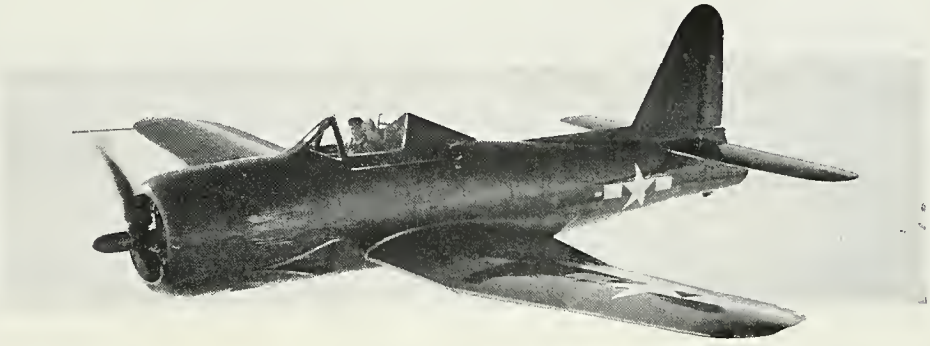


Ryan XFR-4 provided a unique application of the Westinghouse J-34 engine. This plane, which first flew in November, 1946, was a composite aircraft featuring the J-34 in the tail and a conventional propeller-driving engine in the nose.

Westinghouse turbojet engines are used by some of America's fastest aircraft, capable of attaining supersonic speeds and altitudes greater than 52,000 feet.

Load of nails and filler strips for pre-fab grain bins goes aboard Patterson's Super 260 at Grand Island, Nebraska Airport.

SUPER PLANE for a SUPER JOB

WHEN the FLYING BUSINESSMAN CONTEST was launched last November little did the judges expect to find such an imposing contender for top honors in the very first month of competition as George S. Patterson, Nebraska construction superintendent, who flew *six hours every business day* even during winter when personal flying traditionally is in the doldrums in his part of the country.

To give nationwide recognition to companies and individuals like builder Patterson, who use their executive planes as a regular means of day-to-day travel on business engagements, Ryan Aeronautical Company, manufacturers of the Ryan Navion, have established a series of Flying Businessman-of-the-Month awards. Winners are decided on the basis of the greatest amount of flying time recorded each month by Navion owners. An annual trophy for the Flying Businessman-of-the-Year is also awarded.

Patterson's story as the first monthly champ really begins in 1949 when his employer, the John L. Hudson Company, coast-to-coast contractors for pre-fabricated grain storage bins, houses, military buildings and general construction, decided to provide their crack project manager with a Ryan Navion for use in directing a big job in Nebraska for the U. S. Department of Agriculture. Traveling a circuit of more than fifty building sites, Patterson immediately eliminated earlier need of six $150 per week field superintendents. Cost-conscious Hudson executives said, "The plane's the thing," and when, a year later, the company received another large contract from the Agriculture Department they purchased a new Super 260 Navion.

Engraved plaque, presented in ceremonies at Ryan plant, honors George S. Patterson as "Flying Businessman-of-the-Month."

The 1950 grain bin project was the biggest of its type in Hudson's history. Main operations were centered around Grand Island, Nebraska. Other building activity was carried on near Sioux Falls, South Dakota and Fort Dodge, Iowa. Patterson had a hand in all three, but faced his greatest task in personally supervising construction at 54 locations within a 150 mile radius of Grand Island.

Three full trainloads of pre-fab materials chugged into Nebraska from the main Hudson office in Portland, Oregon. The biggest train numbered 87 cars. Five hundred employees set to work laying foundations and erecting structures.

A typical day for Patterson during the peak of the season — as in the month of November — begins with a brief session in his Grand Island office before setting out at 9:30 for Holdredge with a Navionload of nails, bolts, screws and filler strips. Between Holdredge and his second stop, Hastings, he inspects three important jobs from the air. Such aerial inspection gives an accurate check on

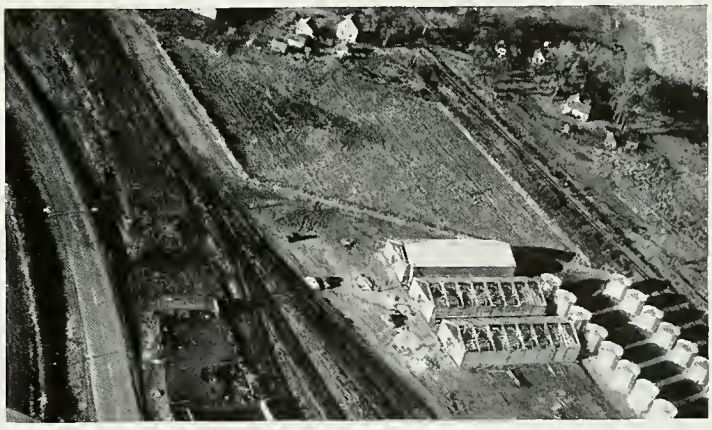
building progress during the previous twenty-four hours. At Hastings he leaves off supplies and picks up a field supervisor with whom he flies to Daykin to investigate trouble reported in early stages of bin construction. While airborne they inspect several more building sites. Leaving this supervisor behind at Hastings, he meets another at Norfolk, with whom he lunches and talks business while the Navion is gassed up. Norfolk is his one airport landing for the day. All the others, save for the return to Grand Island, are made on rough fields of wheat and corn stubble, on pastures and country roads, usually right alongside the bins.

Next comes Ord. Enroute he inspects six more jobs. At Ord he takes aboard a third field supervisor and together they cover a host of additional locations. A low pass over a job is enough to signal workers the boss is going to land. When he doesn't make a landing he frequently flies

(Continued on page 22)

Snow covered runways at the Grand Island airport didn't hold up the Navion's daily operation. While rotary snow plow threw up plume of snow at far end of runway Patterson defied winter to take off on schedule for tour of 54 building locations.

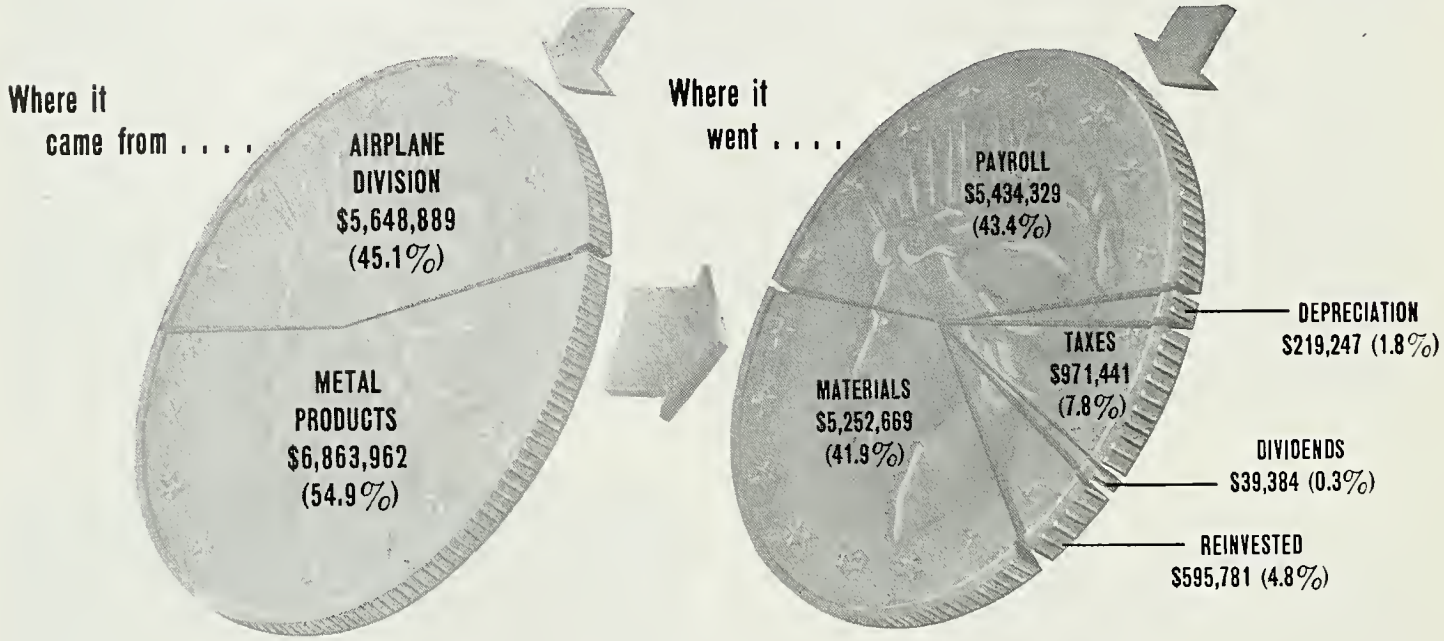
Aerial inspection of grain bins under construction has helped the Hudson Company to eliminate previous need for six high-paid field superintendents. Patterson does all the piloting.



Workers recognize the boss' plane as it makes a low pass over the job at Daykin, Nebraska. Landing close to the bins, Patterson will hold conference with foreman and unload supplies.

THE 1950 BUSINESS

Summary of INCOME and COSTS...and


Where it came from . . . .
AIRPLANE DIVISION $5,648,889 (45.1%)
METAL PRODUCTS $6,863,962 (54.9%)
Where it went . . . .
PAYROLL $5,434,329 (43.4%)
DEPRECIATION $219,247 (1.8%)
TAXES $971,441 (7.8%)
MATERIALS $5,252,669 (41.9%)
DIVIDENDS $39,384 (0.3%)
REINVESTED $595,781 (4.8%)

	TOTAL	PERCENT	Per Ryan Worker
OUR CUSTOMERS PAID US			
For products of our Airplane Division	$ 5,648,889	45.1%	$3613
For items of Metal Products Division	6,863,962	54.9%	4398
TOTAL INCOME	**$12,512,851**	100.0%	**$8011**
In making these products, Ryan paid these bills:			
A. **Cost of HUMAN ENERGY paid for in WAGES AND SALARIES**	$ 5,434,329	43.4%	$3477
B. **Cost of MATERIALS AND SERVICES bought from others**	5,252,669	41.9%	3356
C. **Cost of TOOLS (or facilities) WEARING OUT** (The accounting term is Depreciation)	219,247	1.8%	144
D. **Cost of PAYMENTS ORDERED BY GOVERNMENT** (Federal, State and Local Taxes)	971,441	7.8%	625
E. **Cost of USING TOOLS (FACILITIES OF PRODUCTION)** ***(Profit)***			
"Take-Home Pay" of 1300 Owners (Dividends)	$ 39,384 (0.3%)		
Re-invested in the business	595,781 (4.8%)		
	635,165	5.1%	409
TOTAL COSTS	**$12,512,851**	100.0%	**$8011**

YEAR AT RYAN

..the story BEHIND THESE COSTS

A. COST OF HUMAN ENERGY paid for in WAGES AND SALARIES - - - $5,434,329

The wages and salaries paid to Ryan employees last year took 43.4c of every dollar the company received from its customers. During the fiscal year from October 31, 1949 to October 31, 1950, the average number of employees on the payroll was 1,562. The annual pay of the average worker was $3,477.

In addition to the wages paid directly to all Ryan employees, the company made other substantial payments for such items as sick pay, unemployment insurance tax, workmen's compensation, paid vacations, holiday pay, rest periods, social security and retirement.

In general, the rates of pay increases at Ryan have been somewhat greater than the area cost of living rise in recent years so that workers have been able to maintain or increase their standard of living during their period of employment. In many cases, this period of employment goes back 10, 15 or 20 years, and at present approximately 10% of Ryan employees have been with the company 10 years or more.

Wages and salaries paid to Ryan employees buy homes and furniture, education, television sets, insurance, food and clothing — help make local business prosper. As one of the large employers in San Diego, Ryan's $5,434,329 payroll last year was, for the most part, spent here and added to the high level of prosperity and standard of living in San Diego.

You may be wondering, too, about the pay of executives. You may have an idea that fabulous sums are paid them. Ryan employees would be surprised at the comparatively modest amount received, after taxes, by the men whose initiative and leadership have made possible the many jobs in our plant. These sums represent a minute percentage of the total amount paid in salaries, yet no one will gainsay the fact that the security of the average worker's job depends on the ability of executives to obtain and hold customer business and to manage and plan to keep the plant running efficiently and profitably. The healthy operation and growth of the Ryan company through many years is a measure of the success with which they have fulfilled and continue to fulfill the all-important responsibility of their assignments.

B. COST OF MATERIALS AND SERVICES Bought From Others - - - - - $5,252,669

Out of every hundred dollars taken in by the company, $41.90 was needed to purchase the materials used in making the products we sold our customers. In the course of the past year, the company bought $3,356 worth of materials and services for each and every employee to provide the supplies which keep production lines rolling.

The greater part of the 5-1/4 million dollars spent was paid by Ryan to a broad cross-section of industry which furnishes *materials* such as steel, aluminum, engines, instruments, paint, castings, etc., and *services* such as heat, light, gas, printing, telephones and the many other daily needs.

The money for materials is spent in practically every state and helps to make better business and more jobs in every section of the country. Many of the services we buy are furnished by local firms and contribute to the welfare and prosperity of the San Diego area.

As is the case at Ryan, companies who furnish us materials and services pay an average of about 50c out of every dollar to their employees. Thus, if we add the payrolls represented by the materials and services we buy to the wages and salaries of our own employees, we find that approximately 64c out of every dollar Ryan takes in ends up in pay rolls.

To make certain that we "get our money's worth" and and that the company's "cost of living" is kept within bounds, everything we buy is handled through the Purchasing Department. Our buyers search out every possible source of supplies that meets our Quality Standards, and then buy from the firms that offer the best price and the best delivery. Every dollar thus saved helps us give better value to our customers, do more business, provide better job security and prosperity for all, and serve our country better.

C. COST OF TOOLS WEARING OUT - $219,247

This is the item accountants call Depreciation. It represents a fund set aside to provide for the *replacement* of the tools of production—and by tools of production we mean each and every machine and building we have. During the year we put $219,247 into this fund.

At present prices for new machines, each Ryan worker wore out about $300 worth of tools in 1950, yet the company was permitted to reserve only $144 per employee for replacement of these tools.

The cost of living has gone up for business firms, too. This Turret Lathe was bought in 1948 for $21,300. The price has now jumped to $49,195.

The tax laws allow the company to set aside only amounts *based on original cost.* But with inflation and prices what they are today, regular depreciation allowances are sufficient to take care of only half of replacement requirements.

If Ryan should limit its replacements, year by year, to the amount of its allowed depreciation, its plant would get smaller and smaller, and it would wind up having only half of the equipment it started with.

So - *just to stay even with the game,* stockholders have to make up the difference needed to replace worn-out machines and buildings, by giving up a large share of their "profits." Of course, such so-called "profits" aren't profits at all.

In RYAN REPORTER last year, in discussing the 1949 business report, we told how a slightly used Bullard Turret Lathe had been purchased for $21,300 to help build jet cones for the General Electric J-47 engine. We pointed out that the company would set aside one-tenth of the cost ($2,130 each year) for the next ten years so that when a replacement machine was needed in 1958, the money would be on hand.

That machine is still giving good service, but now we need another like it to further speed jet cone production. We placed an order in November and found the price was now $49,195 for the identical machine! That's the penalty of inflation. If we had to replace the first turret lathe at today's prices, the stockholders would have to dig up $27,894 more than its original cost. When we do replace it in 1958, they may have to dig even deeper.

But, suppose Ryan had not set aside any money at all? What would happen to the jobs of those whose work is directly connected with the tools which will wear out this year? What chance would Ryan have, with obsolete machines, to compete against other companies in obtaining new business?

D. COST OF PAYMENTS ORDERED BY GOVERNMENT - - - - - - $971,441

To carry its share of the expenses of Federal, State and Local governments, Ryan Aeronautical Company paid out the equivalent of $625 for every employee on the payroll last year. That's $52.08 per month per employee. A year ago our taxes amounted to $27.00 per month per employee.

The rates of taxation on corporation income have been increased twice in the past year. For all of us — individual and corporation alike — higher taxes are going to be a necessity in the years ahead to meet the tremendous costs of national defense and our foreign policy. After collecting taxes of 38 cents out of every dollar of corporation gross income, Congress last year passed legislation increasing the rate to be paid on income they had already taxed.

Then, on top of this, a so-called "Excess Profits" tax was passed which was retroactive — that is, it collected taxes covering periods for which company's books may have already been closed. It's much the same as going to the gas station to buy 10 gallons of gas only to be told that you'll have to pay an extra 2 cents a gallon on all the gas you bought during the past three months.

The word "corporation" hardly describes the true nature of the tax collected from business firms. These taxes are paid, not by corporations, but by the customers — you and me — who are the source of corporation income. In setting the selling price of a TV set, for example, the manufacturer must estimate his tax in advance and make it a part of the retail price paid by you, the buyer.

In the role of tax collector, Ryan last year relayed to Federal, State and Local governments $971,441, which we in turn had received from our customers.

These taxes are spent for the support and services of government — national defense, public safety, schools, hospitals, farm subsidies, "free" education and medical services, etc. But nothing which comes from the government is, in fact, "free." Taxes collected from the people are the government's only source of revenue. They must foot the bill.

E. COST OF USING THE TOOLS OF PRODUCTION (Profit)

Take-Home Pay of Owners (Dividends) $ 39,384
Money Re-Invested (Earned Surplus) - 595,781
$635,165

Here's where we all really get confused. "Profit" and "Surplus" are without doubt the two most misunderstood words in financial terminology. The accountant knows their meaning precisely, but the man-on-the-street has only a vague idea of what these terms really represent. Actually they are the costs paid *by the customer* for the *use* of the machines, buildings and other *tools* needed to *make the products* he buys.

If you suggested to your wife that she go into the garden and pick some *Lathyrus Odoratus* she'd have no idea what you meant, but a botanist would know immediately you meant "sweet peas." Botanists use the Latin names so that botanists everywhere will know exactly what they're talking about.

Financial terms are similarly needed which have a precise meaning universally accepted throughout accounting, financial and statistical fields. Unfortunately, these technical terms often give a concept completely at variance with the actual facts.

When a company reports a profit, most people think of the sum as an actual amount of cash — a bag of money stored away in a vault — which is left over and above the company's actual needs. But let's see what "profit" and "surplus" are.

Profit is made up of two things — (1) the take-home pay (dividends) of the stockholders, and, (2) what is re-invested in the business (earned surplus).

Of every dollar due the owners this year, 6 cents was paid in dividends and 94 cents reinvested. To state it another way, Ryan's 1,300 owners had an average "take-home" pay of just $30 for the year. The rest of their "profit" — called "earned surplus" — amounted to $458. It wasn't surplus in the sense that it was something not needed for the business. Actually it went right back into the business in the form of new machines and equipment, to pay for research and to continue progressive growth.

When stated in personal terms for the individual, profit may be more easily understood, Profit — the difference between the ordinary cost of living and the weekly pay check — is what enables a man to buy a house, an automobile, or a new stove. Profit works the same way for companies. No one would think to call a man's house "surplus," yet in accounting terminology that is what his house is.

When some people read that Ryan made a "profit" last year of $600,000 and has an "earned surplus" which now totals $4,000,000, they believe that the company has $4,600,000 in cash, and that $4,000,000 of that is a surplus above what we need! Nothing could be farther from the truth.

As explained in the Simplified Balance Sheet on Page 9, the stockholders' equity is partly in cash, but mostly in buildings, equipment, inventories of material and work in process without which the company could not provide its 2,950 jobs. These are the things essential to growth and to stability.

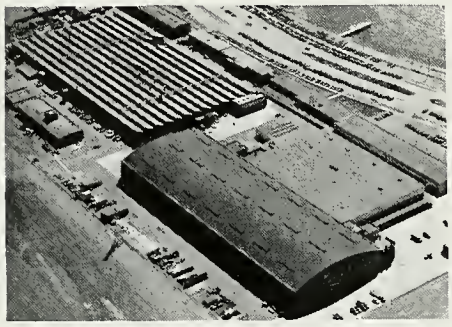
The public's real concern should be that a company may not make *enough* money to keep its tools (plants and equipment) up-to-date and thus provide secure jobs for its workers.

We call our system "free enterprise" or the "profit" system, forgetting that it is actually the PROFIT AND LOSS SYSTEM, for there is no guarantee of profits; and periods of loss for even the most carefully managed companies are an ever-present possibility.

You may wonder why the item accountants call profit is identified here as a *cost*. It varies in size from year to year. It cannot be paid until other costs are paid. In a year of loss, all the money from customers, plus reserve funds belonging to the owners, must be used to meet the costs of payrolls, materials, taxes, depreciation, etc. Profit is a *cost*, too. To believe otherwise is to assume that the owners who provide the tools are so charitable they would give each of us the tools with which we earn our living and expect nothing in return.

We understand the importance of tools better when we glance backward 100 years. Then, tools did 2% of the work, humans 22% and animals 51%. By 1944, humans were doing 4% of the work, animals 2% and *TOOLS* 94% *of the work.*

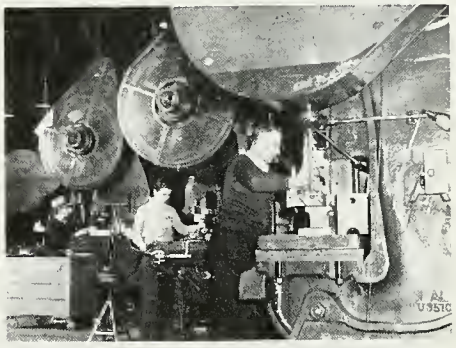
The Job Done By The Stockholders



They Bought or Leased All the Land and Buildings Used by the Company

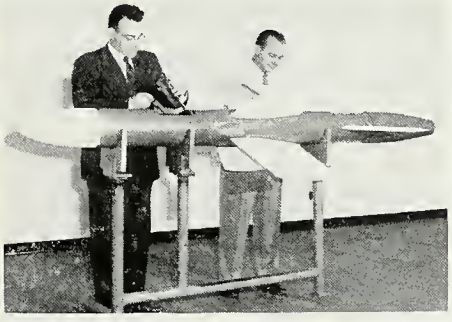
Ryan Has 1300 Stockholders

They Made Available the Money for Payrolls — in 1950, $5,434,329

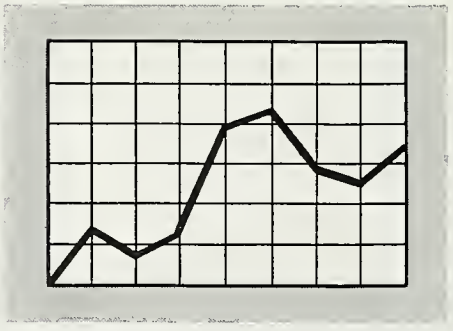


They Provided the Equipment and Machinery We Use

They Provide Money Ryan Needs for Work in Process



They Finance Research and Development — Jobs for Tomorrow

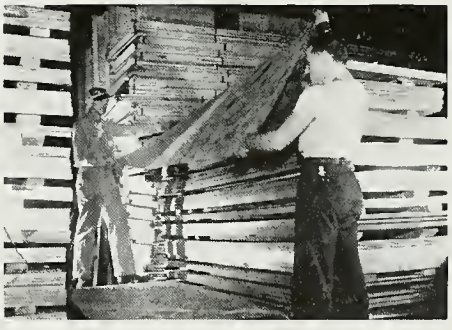


In Good Years, They Make a Profit; in a Bad Year They Take a Loss

Simplified Balance Sheet

RYAN OWNS (*Assets*)	**$8,196,009**
RYAN OWES (*Liabilities*)	**3,184,620**
NET WORTH (*Assets less Liabilities*)	**$5,011,389**
ORIGINAL STOCKHOLDERS' INVESTMENT	**$ 952,632**
RE-INVESTED IN PAST 20 YEARS	**4,058,757**
TOTAL STOCKHOLDERS' EQUITY	**$5,011,389**

The stockholders' equity is mostly in buildings, equipment, inventories and work in process without which the Company could not provide jobs for its 2,950 workers. Very little is in cash.



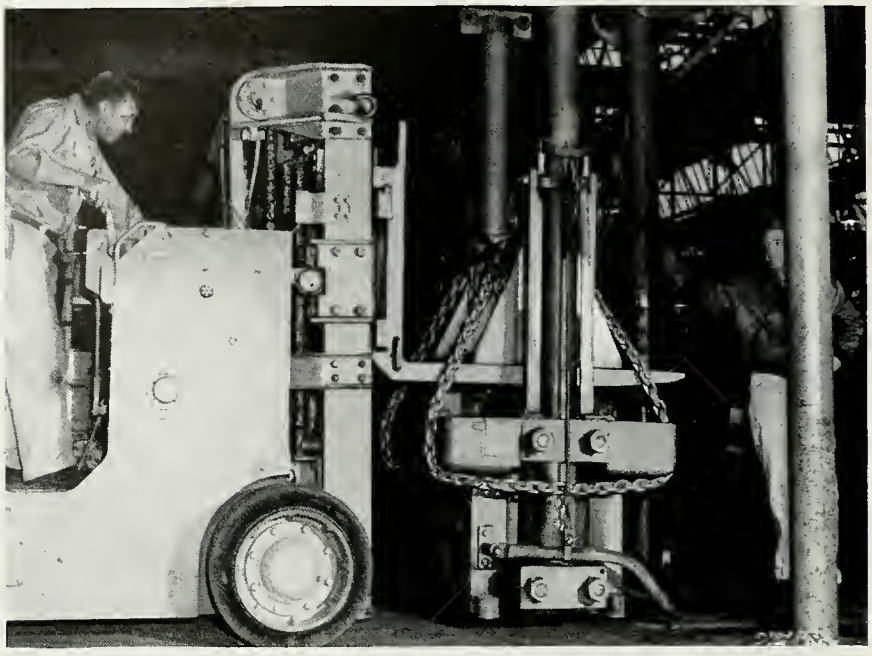
In 1950, They Made the $5,252,669 for Materials, Supplies and Services Available

The INS and OUTS of

WHETHER it be a five-ton die for a drop hammer or a fragile electronic measuring device, a phone call to In-Plant Transportation will bring a truck, fork lift, crane or other appropriate equipment to move it in a matter of minutes.

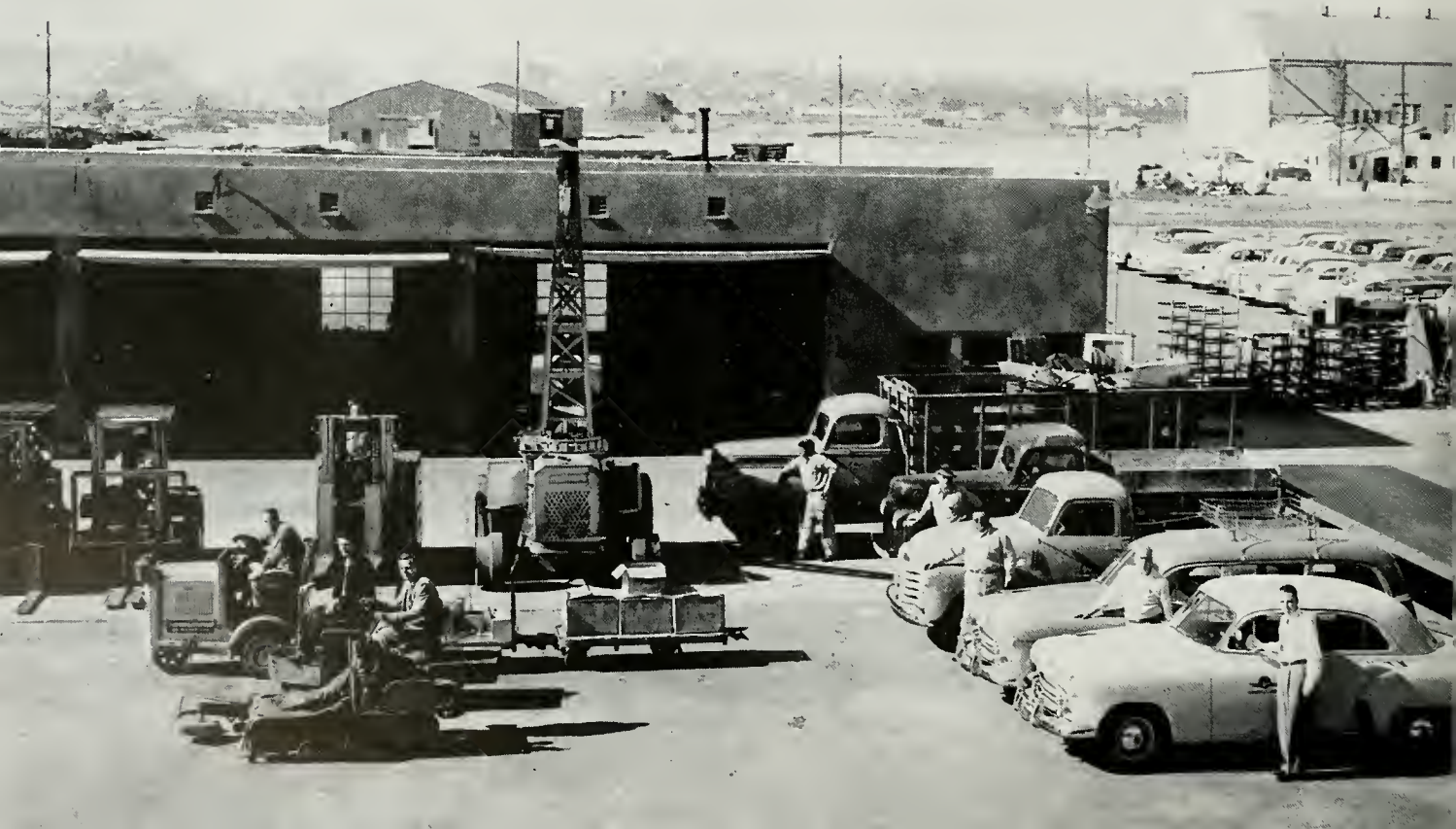
A host of assorted Ryan in-plant vehicles answer dozens of such transportation requests each day. Never does a call wait more than thirty minutes; usually the time elapsed before actual moving begins is just enough to allow the operator to drive his vehicle to the scene.

Transportation is perhaps best known for the daily chore of delivering all incoming supplies and equipment from Receiving and Receiving Inspection to stores, the stockrooms or the production and administrative departments which have the materials on order. Two men with "Banty" and Clark fork lifts are

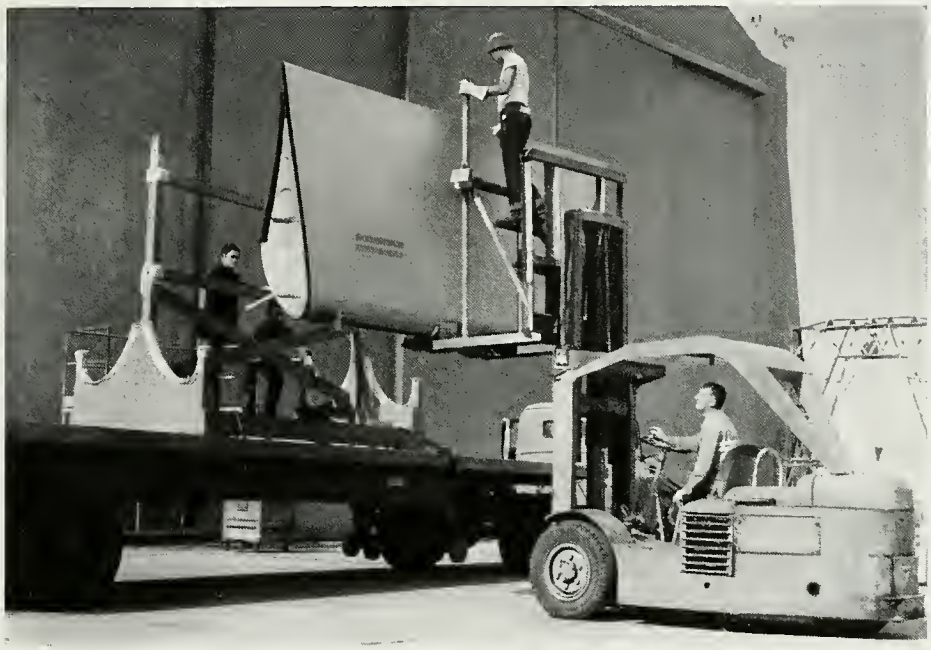


New drop hammer weighing six tons goes into position with help of an Electric Automatic lift whose other duties include moving dies for hammers and presses.

Transportation: "Inside & Out." Cars, trucks and bus are typical of Outside fleet. Variety of vehicles at left do the Inside jobs.



TRANSPORTATION



Inside and Outside Transportation combine forces as Clark fork lift carefully places huge B-36 flap aboard special rack on trailer for delivery to Convair's main plant.

10,000-lb. capacity Hughes-Keenan crane and 3-wheel motor scooter dramatize the "big and little" of Inside Transportation.

Ryan
THE RYAN AERONAUTICAL CO.

Milt Johnston, supervisor of transportation activity, has been at Ryan since '44.

regularly assigned to this "beat", but can call for bigger equipment and more men when necessary.

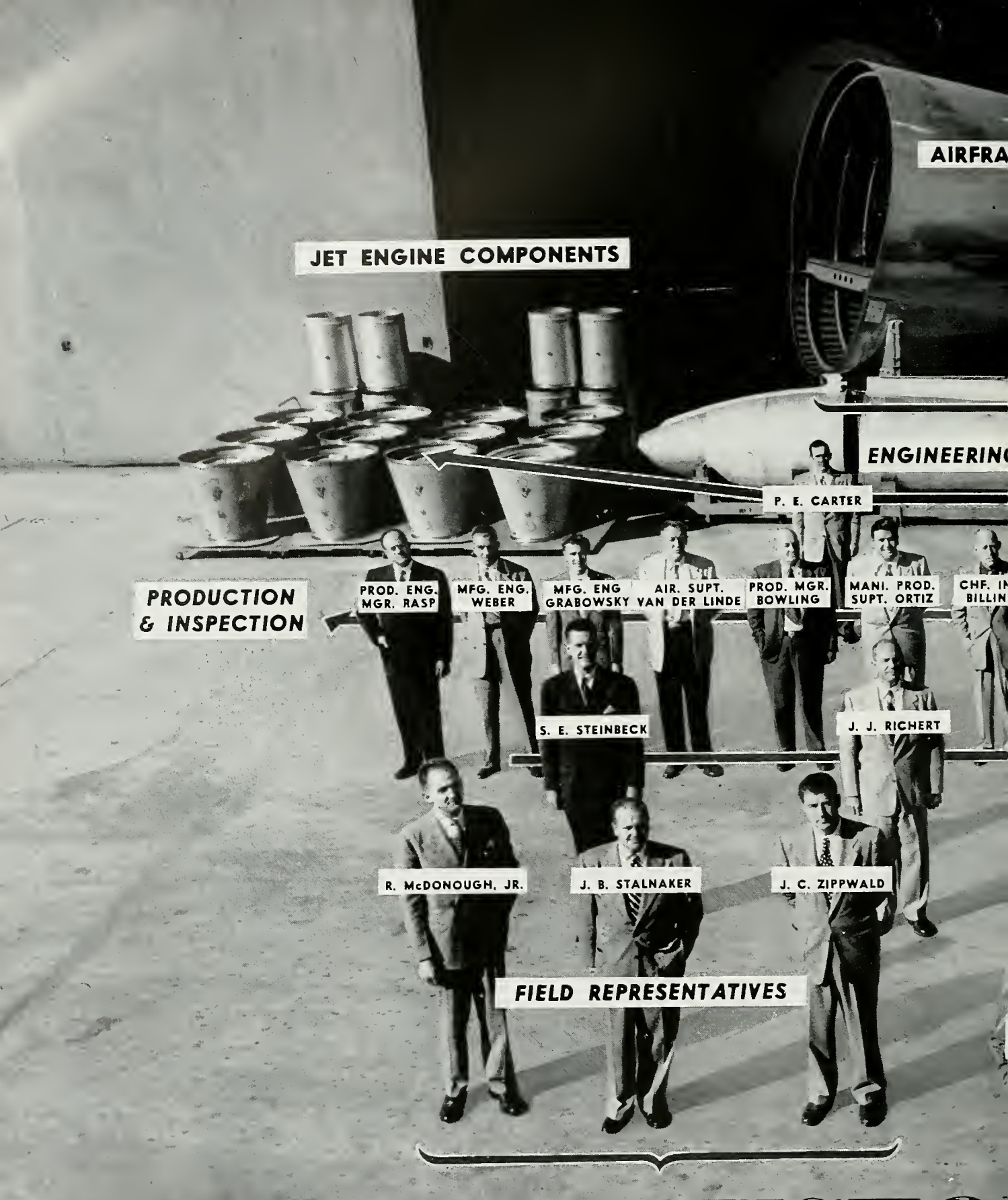
Should all equipment be in use when there's a RUSH request (e. g. when a die must be moved immediately to prevent a hold-up in production on urgently needed manifold parts), Transportation Dispatcher Eugene Larson jumps on his bicycle and tracks down one of his fork lift teams in some corner of the 35-acre plant area to reroute them from a routine assignment to the top priority project.

Six specially trained drivers are Transportation's trouble-shooters. When a department, say Tooling, calls for help, Dispatcher Larson requests information about the item being moved, where it is going and what type of equipment Tooling believes will best handle the job. In his permanent log of such requests, he records the name of the driver and the type of equipment dispatched.

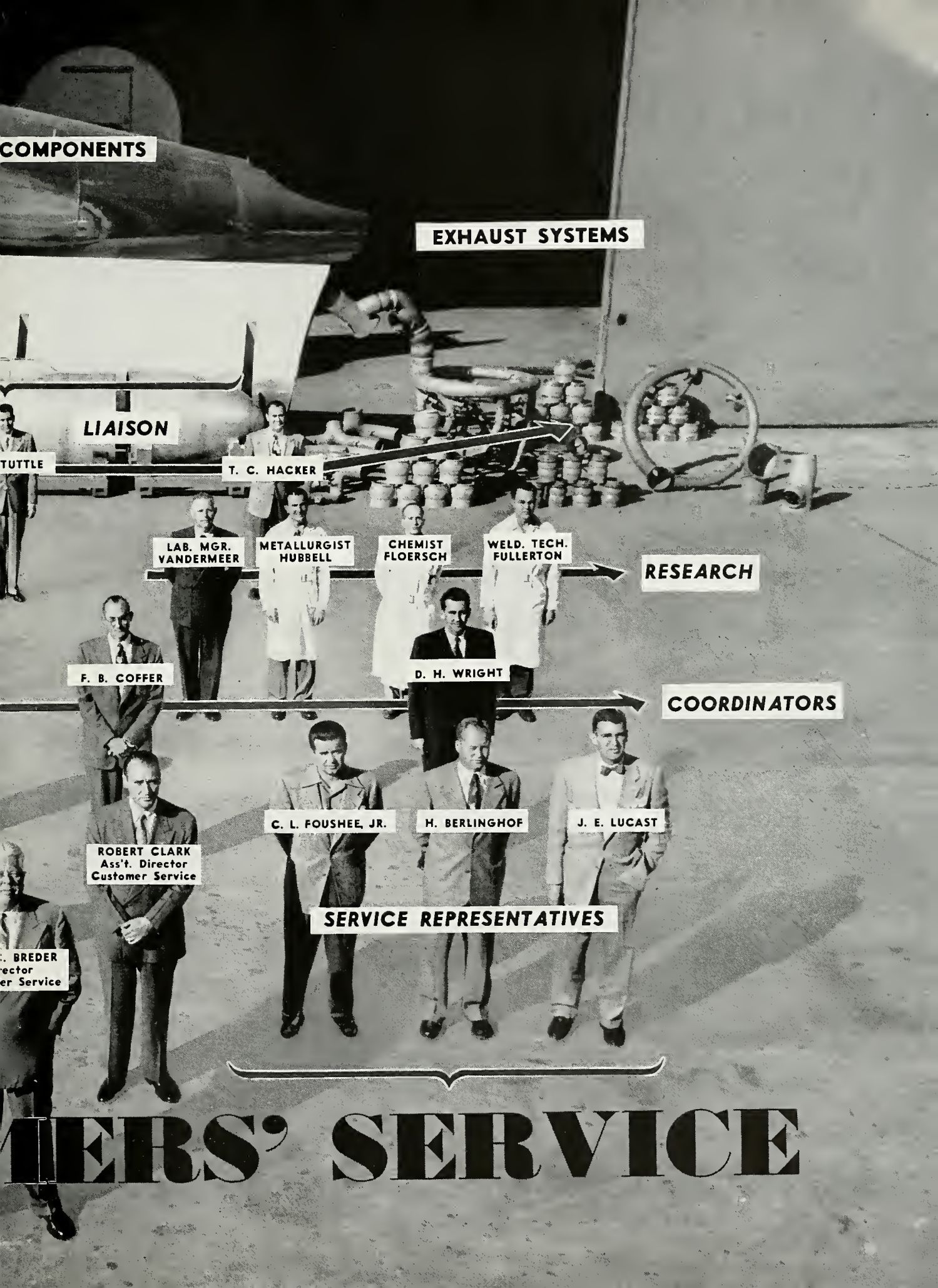
If Tooling specifies that three jigs must be moved to Jet Assembly, Larson will probably send Roy Agular with a

(Continued on page 24)

Vehicle No. 87 is a 600-gal. tank truck assigned to hauling away the sludge from carbides used in the welding department.


JET ENGINE COMPONENTS
AIRFRA
ENGINEERIN
P. E. CARTER
PRODUCTION & INSPECTION
PROD. ENG. MGR. RASP
MFG. ENG. WEBER
MFG. ENG GRABOWSKY
AIR. SUPT. VAN DER LINDE
PROD. MGR. BOWLING
MANI. PROD. SUPT. ORTIZ
CHF. IN BILLIN
S. E. STEINBECK
J. J. RICHERT
R. McDONOUGH, JR.
J. B. STALNAKER
J. C. ZIPPWALD
FIELD REPRESENTATIVES

AT OUR CUSTO


COMPONENTS
EXHAUST SYSTEMS
LIAISON
TUTTLE
T. C. HACKER
LAB. MGR. VANDERMEER
METALLURGIST HUBBELL
CHEMIST FLOERSCH
WELD. TECH. FULLERTON
RESEARCH
F. B. COFFER
D. H. WRIGHT
COORDINATORS
C. L. FOUSHEE, JR.
H. BERLINGHOF
J. E. LUCAST
ROBERT CLARK
Ass't. Director
Customer Service
SERVICE REPRESENTATIVES
. BREDER
rector
er Service
MERS' SERVICE

....And the MEN who BUILD the PRODUCTS

NEITHER the large photo-diagram on the previous page, nor the above photo of foremen and the products whose manufacture they supervise, conveys in full measure the total experience which Ryan places at its customers' service.

Actually, the know-how of 2937 workers is being brought to bear on the problems which arise from day to day in connection with the extensive programs Ryan is conducting for its customers. Tomorrow that number will be 2962 workers; next week, 3035 employees; next month, 3150.

In every organization there are "key" people; and in Ryan's relations with its customers, these key people are the 26 pictured men on the preceding page. They are the men who are the "point of contact" with Boeing, Convair, Douglas, Fairchild, General Electric, North American, and Pratt and Whitney — to mention but a few of the airframe and engine companies for whom Ryan is building major assemblies. These are the men who also provide liaison with the Air Force, Army and Navy, and with the commercial airlines.

Customer Service is a close-knit, hard-hitting organization which provides service before, during and after production of components for other manufacturers. "Field Representatives" with offices in Dayton, New York, Seattle and San Diego provide sales engineering consultation before production. "Coordinators" look after the stacks of paper work which keep the job running smoothly during production. And "Service Representatives" see that customers receive follow-through service after production. The responsibilities are, of course, not as clean-cut as that, for each group contributes something to the work of other groups and to the over-all success of the job.

Assembling this group of "key" service people for the photo-diagram was no small task. The past holiday season gave the photographer his best chance to get them together, but, even so, John Atha, field representative at Dayton, was too busy on liaison assignments at the Air Materiel Command to return to the factory for the periodic conference held at the factory in early January. Similarly, production and manufacturing engineers who should have been included in the picture were attending out-of-town conferences with customers.

John Atha

Whether at the Ryan factory or at customers' plants, manufacturing engineers and top production and inspection personnel are available to the prime contractor to exchange know-how, assure precision workmanship and quality, break bottlenecks and, in general, "get the job done."

Tackling the complex problems of the scientific laboratory, and working in close harmony with the technical experts of its customers, are members of Ryan's laboratory staff which includes metallurgists, chemists, welding technicians and other specialists who can unravel the mysteries of present day industrial science. And in the field of engineering, Ryan provides engineers on customer projects with long background and special knowledge of jet engines, airframe components and exhaust systems.

RYAN "BIRDS" FLOCK TOGETHER

By Don Downie, West Coast Editor, Skyways Magazine

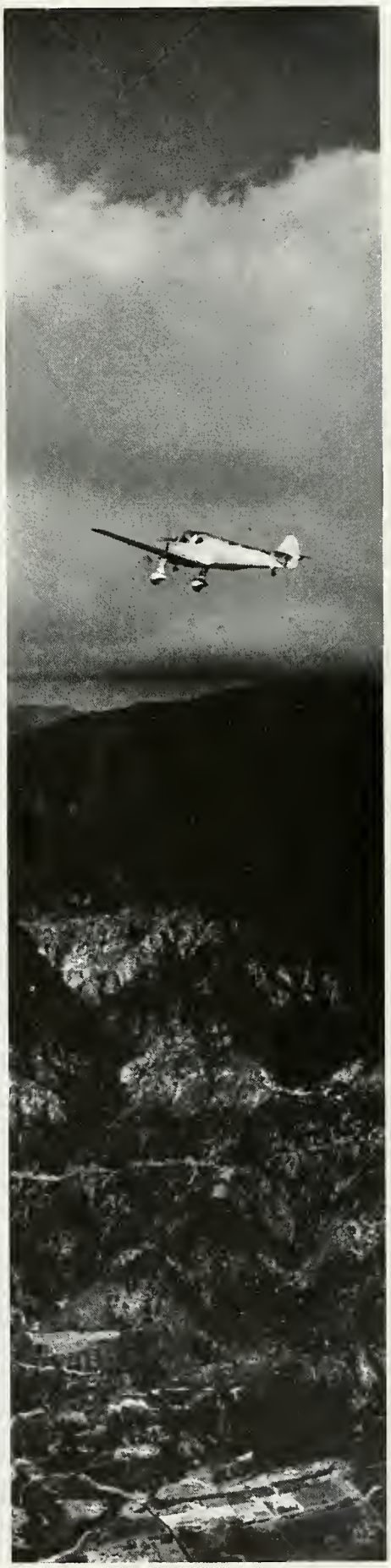
AMONG seafaring folks there's the saying that "old sailors never die." Around pilots the aeronautical parallel might well be "good old airplanes still fly." Here's an illustration of that point —pictures and all.

Twelve years ago, before the war orders of World War II caused a suspension of commercial plane production—much as the Ryan Navion program is now being limited because of the importance of military orders—Ryan Aeronautical Company was building an advanced design metal cabin plane, the S-C. Enough of these S-Cs came off the assembly line, however, so that quite a number are still flying today. Despite their age, they look as modern as they did twelve years ago, and even beside the up-to-the-minute Ryan Navion, they easily hold their own in appearance and design features.

Actually, there is a surprising similarity between the 1938 Ryan S-C and the 1951 Ryan Super Navion. Like the new Navion, the Ryan S-C had that all-metal, low-winged design. It was stall and spin resistant, had a sliding canopy for tops in visibility, and was nearly as safe and easy to fly as its present-day Navion counterpart.

Last year I delivered my fourth Ryan Navion. Three previous Navions had gone to Aviation Consultants in Reading, Penna., and each trip resulted in a story for SKYWAYS Magazine. This particular

(Continued on page 22)



Above the Sierra Madre Mountains near Pasadena's California Institute of Technology, a Ryan S-C conducts rain-making experiments with dry-ice. In photo below the same S-C is pictured at Hermosillo, Mexico, between two Ryan Navions, one of which author Don Downie was delivering to a customer in Latin America.

TURNABOUT

. . . is fair play, as Donald Douglas returns the compliment to T. Claude Ryan

BACK in 1920, a young engineer named Donald Wills Douglas moved his family from Baltimore to Santa Monica, California, and set himself up in business as an airplane builder. His first product, forerunner of more than 35,000 aircraft which carry his name and fame around the globe, was a single-seated bi-plane called the "Cloudster."

Several years later when T. Claude Ryan was operating the "Los Angeles-San Diego Air Line" and needed a larger plane for the run, he purchased the "Cloudster" from Douglas. In his shops, Ryan and his mechanics redesigned and converted the "Cloudster" from a plane with three open cockpits to a "modern" airliner carrying ten passengers in the cabin, and pilot and mechanic or co-pilot in the forward open cockpit. On many of the daily schedules, Claude Ryan was at the controls with John van der Linde, now airplane production superintendent, in the co-pilot's seat.

Some 25 years after transfer of the "Cloudster" to Ryan, Douglas reciprocated by purchasing a Super 260 Navion built by Ryan.

For the past six months the neat and nifty Navion has been performing yeoman duty as a utility airplane for the Douglas flight test division headed by Donald W. Douglas, Jr. All 20 Douglas pilots have checked out in the Super 260.

Flight tests on the half-dozen airplanes under development by Douglas are conducted at Santa Monica, Long Beach and Los Angeles Municipal Airports as well as Edwards Air Force Base (Muroc) and Palm Springs.

That means pilots, mechanics, equipment and small components must be shuttled quickly from the three manufacturing plants involved to wherever the test aircraft happen to be.

"We find the Ryan Super 260 Navion ideal for these trips," declares John F.

A proud and useful member of the Douglas fleet of utility aircraft is the Ryan Super 260 Navion, shown against background of two mammoth Douglas C-124s and one C-74 transport (nearest camera). Navion shuttles personnel, equipment, plane parts.

T. Claude Ryan used this first of a long line of Douglas planes for his Los Angeles-San Diego Air Line a quarter century ago.

Martin, Douglas chief test pilot. "We can haul two or three people and an assortment of cargo quickly and cheaply in the Navion."

Long Beach calls the Santa Monica home office: "We need a crew to take a C-124 on a test hop."

The crew grabs flight gear, jumps into the Navion and is ready to rumble down the runway in the huge Globemaster within 30 minutes.

Motion pictures are taken of instruments during a test flight of the big DC-6A Liftmaster at Palm Springs. Aerodynamics and other engineers want to evaluate the results before the next flight is made. So the cans of film are tossed into the Navion and flown back to Santa Monica for processing and study.

A hydraulic valve on the XA2D isn't working right and the tail-wheel tire needs replacement. The Navion picks them up at the El Segundo plant and returns to Edwards Air Force Base in a double jiffy.

"There's usually a full passenger load on each flight," says Paul A. "Pete" Leaman, who logs most of the pilot time in the 260. When there isn't, you can bet Pete has a load of important parts, which are needed badly on a hot project. Removing the Navion's canopy, Douglas line mechanics use a crane to put aboard such sizable items as 300-pound turbine wheels for jet engines. Pete says they "put aboard everything on which we can close the canopy."

And so it goes every day. The monoplane painted in the special red, white and blue markings used by Douglas for its own demonstrator and executive aircraft is seen so many places so often, some observers might believe the company was operating a fleet of Navions.

Besides its longer flights, the Navion is used frequently for shuttle trips between the main plant at Santa Monica and the Long Beach factory. Thirty-five miles distance through congested traffic, the plants are only minutes apart by Navion.

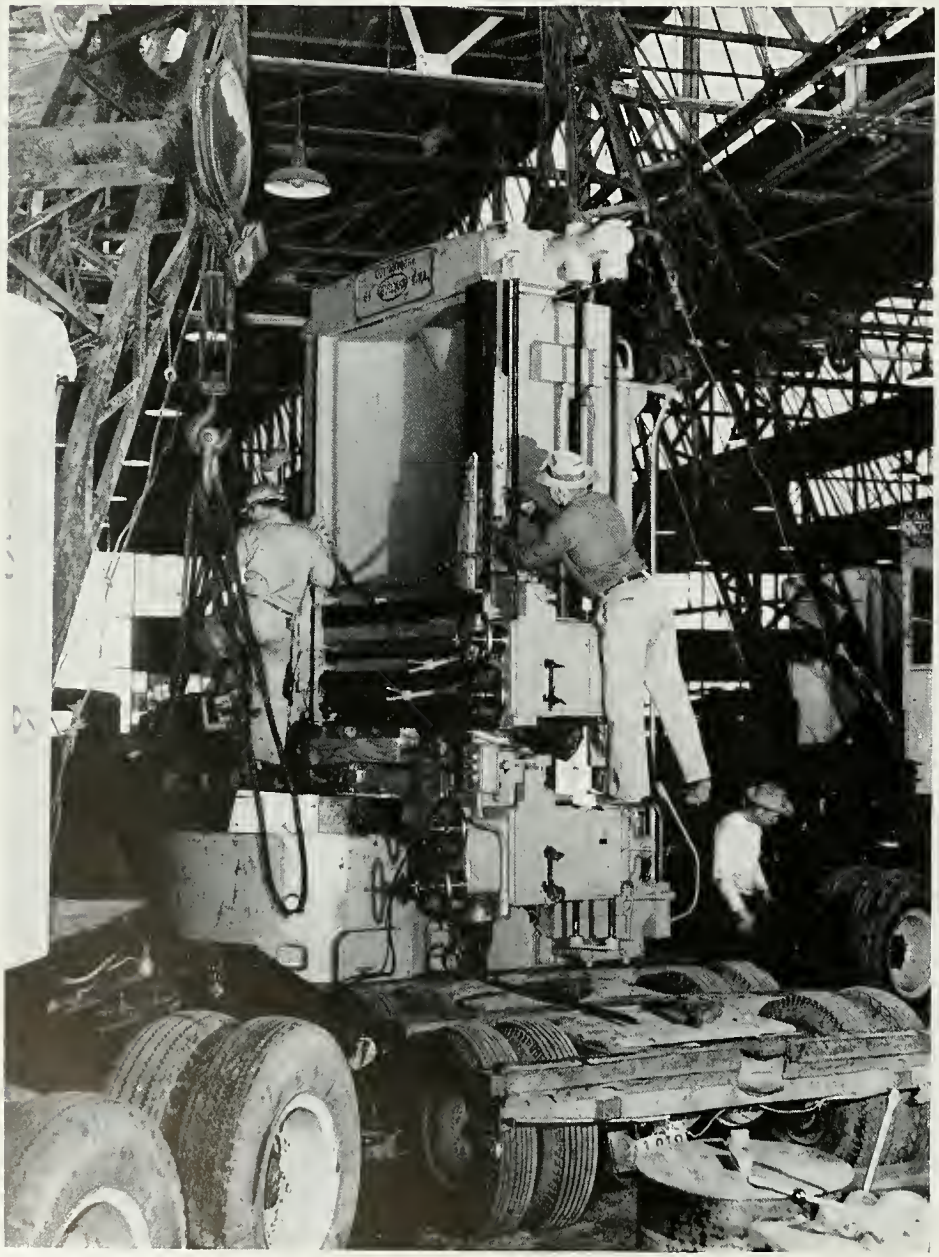
Many of the tasks now performed by the Navion were formerly done with the Super DC-3 executive plane operated by

(Continued on page 20)

Emblazoned on the Ryan Super 260 Navion is the familiar Douglas Aircraft Company globe-girdling insigne. Douglas chief test pilot John F. Martin is at controls.

CUT MASTER

The West's tallest lathe speeds work on jet engine parts for Ryan customers



A NEW and - - for this Western region - - unprecedented machine tool has come to Ryan. In the language of production engineers, it is the vertical turret lathe with the highest boring mill with raised bed ever installed on the Pacific Coast.

The new machine is an immense (32 tons; 13 feet high) Bullard Cut Master, called "Hi Boy" in deference to 24 extra inches of height for its bed as compared to the standard vertical Bullard. The loftier bed places the 64-inch diameter turning table in the most advantageous position for accomplishing specialized milling on unusually tall parts. Metal sections measuring from one-half inch to just under 7 feet in height are turned with ease.

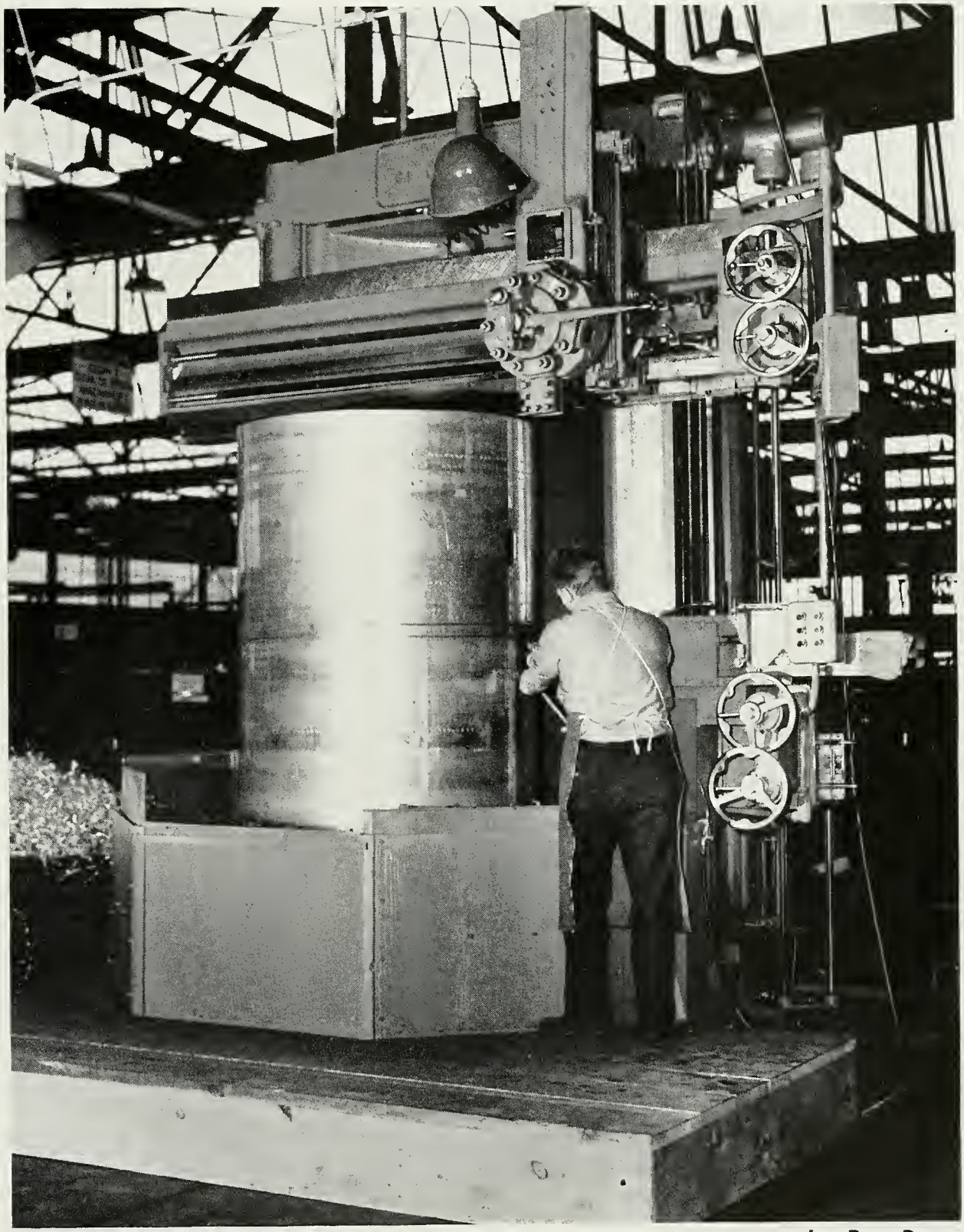
Constructed in Bullard's plant at Bridgeport, Conn., the Hi Boy was shipped by rail direct to Ryan on a low-bed flat car that was designed for heavy machine tool transport.

Billie B. Lair, service representative for the West Coast Bullard distributor, and Darwin Whetstine, foreman of Ryan's jet assembly department, estimate

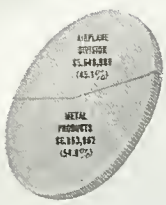
(Continued on page 22)

Part of the main factory building wall was dismantled to permit moving the new Bullard "Hi Boy" into the machine shop.

Despite its extreme vertical dimension, an external fuel tank mid-section easily fits the 13-foot high lathe for "turning."



64" Bullard Turret Lathe *by Don Doerr*



THE STORY BEHIND THE COMPANY'S $12,512,851 IN SALES IN 1950

Of the company's $12,512,851 gross revenue (sales), the Airplane Division contributed $5,648,889, or 45% of the total money taken in during the 1950 fiscal year, while Metal Products Division sales of $6,863,962, accounted for 55% of the total.

Airplane Division sales were somewhat less than last year, while the Metal Products Division sold more exhaust systems and jet engine parts than in 1950. Taken together the sales of both divisions were 17% less than the prior year, when gross income was $15,014,564.

AIRPLANE DIVISION

Our Airplane Division makes three types of products: (1) Commercial airplanes, (2) Airplane assemblies for other companies, and, (3) Military aircraft items.

The number of Ryan Navion commercial airplanes built and sold in 1950 was approximately the same as in 1949. However, the dollar volume was $388,073 greater because we built a higher-powered and higher-priced model and maintained a better and more realistic ratio between manufacturing costs and selling price.

During 1950 we built just a little over half as many Airframe Assemblies as we did in 1949; and the revenue from Military Aircraft items was only 40% of what it was the year before. The lesser volume of these items was the principal reason the total sales for all Ryan products was 2½ million dollars less than in 1949.

For accounting purposes the company's year ends October 31, so the effect of the expanded military aircraft program, due to the Korean War and the necessity of meeting the threat of Communism, was not felt in the period covered by this report.

Ryan Navion

Anticipating the scarcity of materials and the necessity of all-out military production, the management reached the decision some months ago to limit Ryan Navion commercial plane production to the number which could be built from materials and equipment already on hand or on order. A much larger number could be sold because of the heavy demand for the improved 1951 Super 260 model, but a suspension of production of commercial planes was more in the national interest and also was believed to represent a sounder business course to follow.

While no Navions for military use were built last year, a new model especially suited to the requirements of the Air Force, Army and Navy was developed and demonstrated. Results of the evaluation of tests by the military services are not yet known. If the Navion is selected, production of military models will get under way soon, and commercial airplane manufacture, it is hoped, can again be active after the National Emergency is ended.

Airframe Components

Work on Boeing C-97 fuselage sections was stopped for a period during the year due to a delay in procurement by the military services, but is now on an accelerated basis which will continue into 1952. Cargo doors and floor beams for the C-97 are also in production and, in addition, the company has new contracts for other components for this same military transport.

A special type external fuel tank for military planes was developed by Ryan during the year and production against a large contract requiring a build-up to a volume production rate is now under way. A modification and rebuilding program on wing flaps for Convair B-36 bombers was also conducted.

Military Aircraft and Research

Development and manufacture for the advance-type Ryan designed XQ-2 jet-propelled pilotless target plane continued throughout the year under joint sponsorship of the Air Force and Navy. On this project, Ryan is performing the important electronic development phase as well as the basic airplane design. A number of other important research projects, which cannot be described due to security regulations, are being conducted for the Air Force and Navy.

METAL PRODUCTS DIVISION

The activities of this major division during 1950 still more firmly established the company as a leader in aeronautical products designed and built of heat and corrosion-resistant stainless steels. These products fall into two general classifications: (1) Exhaust systems and allied products for conventional piston type engines, and, (2) Jet and rocket engine components.

Exhaust Systems

As in the past, Ryan continued as a major supplier of exhaust systems for most of the commercial airliners, military transports and bombers, especially the multi-engine types. The company now also builds exhaust systems for the General Patton M-46 and other tanks, and numerous new items are under constant development. Engine manufacturers as well as aircraft manufacturers are now customers for the company's exhaust systems.

Jet Engine Components

The volume of jet engine work done during 1950 was double that of 1949 and the volume now scheduled is substantially larger than at any time since the company entered this field. Largest volume units in production are exhaust cones and other assemblies for the General Electric J-47 jet engine, and tailpipes for the jet engine pods installed on Boeing B-47 Stratojet and Convair B-36 Intercontinental bombers.

Employees of the Ryan Aeronautical Company who would like to receive a copy of the Annual Report as sent to all stockholders may leave their request with the Personnel Department or drop a note in Inter-Department Mail addressed to Public Relations, Room 108. These reparts are available to employees as long as the supply lasts.

TURNABOUT

(Continued from page 17)

Douglas. The Navion even has been used for aerial photography of DC-6s prior to delivery to domestic and overseas airlines.

Although the Navion can't maintain the 300 mph. speed of the big, four-engined airliners, satisfactory photos have been made by having the two planes fly in a large circle, with the big ship on a longer radius. The cameraman shoots through the rear seat window with the glass removed.

The Navion bears license N-300, a diminutive version of the traditional "30,000" which Douglas has always used for executive DC-3s and the present Super DC-3.

Since the Douglas DC-3 already has acquired the title of "Work-horse" airplane, the Ryan Super 260 Navion will have to settle for "Work-pony." But it is a thoroughbred.

van der Linde Named Production Manager

H. J. "John" van der Linde, who joined the Ryan organization 28 years ago, has been advanced to the position of Production Manager, T. Claude Ryan, president, has announced.

Starting as a flight mechanic and co-pilot on the Los Angeles-San Diego run of Ryan Airlines, Inc., in 1923, van der Linde has held many key posts with Ryan, his most recent having been Airplane Production Superintendent.

CLARK

Robert L. Clark, former assistant director of Ryan's customer service department, has been appointed Assistant Production Manager under van der Linde, and Jack C. Zippwald was advanced from field service representative to Clark's previous position in customer service.

ZIPPWALD

In a realignment of factory service functions, the production engineering division under H. P. Rasp has been enlarged in scope to include production control and methods engineering, and will be known as the Factory Service Division, with Rasp as manager.

Van der Linde, who came to San Diego at the age of 19 from his native Netherlands East Indies with his parents, has supervised the assembly of every Ryan model from the slow biplane types of post-World War I and the Ryan M-1 which pioneered air-mail service on the West Coast to the high-performance jet-pushed, propeller-pulled Fireball Navy fighter and the sleek, four-place Navion executive-liaison plane.

RASP

NAVY TURBOJET PIONEER

(Continued from page 3)

In March 1943, just sixteen months after the engineers went to work, Westinghouse had two different engines ready for the Navy.

The first engine was the Model 19A which has a diameter of 19 inches and produced 950 pounds of static thrust. By the end of 1944 this engine had been redesigned and its performance improved substantially. The static thrust of this redesigned engine, officially designated as the J30 had been increased to 1600 pounds and the specific fuel consumption reduced from 1.41 to 1.15 pounds fuel per pound thrust per hour.

Model J30 engines were used to power the McDonnell FH-1 "Phantom," which in July of 1946 made aviation history as the first all-jet airplane to take-off and land on a U. S. aircraft carrier. (A Ryan FR-1 Fireball jet-plus-propeller Navy fighter had earlier landed aboard a carrier with jet power only). The Navy's first all-jet carrier based operational squadrons were comprised of FH-1 aircraft.

The second, a smaller engine, was only 9.5 inches in diameter. Designated the J32, it was used to power the pilotless target drone "Gorgon." The engine, the smallest of its kind at the time, weighed only 150 pounds, produced 250 pounds thrust and rotated at the amazing speed of 34,000 rpm.

Design work on the third Westinghouse engine model, the J34, was started in 1944 and the first engine came to test in April of 1945. The first production model, the J34-WE-22, rated at 3000 pounds thrust, was first operated in May 1946.

A unique application of a J34 engine was in the Ryan XFR-4, which first flew in November, 1946. The XFR-4 was a composite airplane which featured a J34 in the tail and a conventional propeller-driving engine in the nose. This airplane was one of a series developed for the U. S. Navy by Ryan to investigate the performance of jet powered aircraft under aircraft carrier operating conditions. The basic design of the airplane proved so versatile that it was used to test the effectiveness of many combinations of power plants including turbojets, turboprops and reciprocating engine.

The J34 engine also played an important role in the development of re-heat thrust augmentation for it was this power plant which Ryan Aeronautical Company used in the research program for its afterburner.

The J34-WE-34 engine, which is now in quantity production has demonstrated exceptional reliability by having successfully completed three consecutive 150-hour test runs. The same engine was used during the entire 497 hours of testing which were completed with essentially no replacement of parts. Another J34-WE-34 engine recently completed, on its first attempt, the new, more difficult 150-hour type test. This was the first engine of any make to attempt the exacting requirements of this new test.

Another tribute to the reliability and high performance of the J34 is the recent certification of the engine for use in commercial airplanes by the Civil Aeronautics Administration.

The J34 engine has been very well received by the aviation industry. Its slim lines, low frontal area and light weight make it ideally suited for all types of installations. Airplanes powered by these powerful J-34 engines have attained altitudes in excess of 52,000 feet and have traveled faster than the speed of sound.

SOME of the notable installations of the J34 in top Navy fighters are the McDonnell F2H "Banshee," Douglas F3D "Skyknight" and the Chance Vought F7U "Cutlass." Two of the most promising airplanes in the USAF penetration class, the McDonnell XF-88 "Voodoo" and the Lockheed XF-90, are each powered by two J34 engines. Other airplanes which use this engine model are the Douglas D558-II "Skyrocket," Chance Vought F6U "Pirate," and the McDonnell XF-85 "Goblin."

The accomplishments of the past ten years have been many but the aviation industry and Westinghouse are not content to rest on their laurels. The facilities of the multi-million dollar Aviation Gas Turbine Laboratory are being utilized around the clock to test and develop new designs originated by veteran gas turbine engineers. The total energy of the Aviation Gas Turbine Division is devoted to the task of providing engines with even greater power, lower weight, longer life and the utmost economy of operation.

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William P. Brotherton, technical editor
Harold Keen, associate editor
Don Doerr, chief photographer
William Wagner, editorial director

RYAN "BIRDS"

(Continued from page 15)

flight was to Latin America. In landing at Hermosillo, Mexico, on the first day's flight, I found NC 18911, a Ryan S-C owned by Lee Lassner of Monrovia, Calif., already parked on the flight line, and next to him a Ryan Navion owned by Dr. Vinton A. Mueller of Reno, Nevada.

On returning to California I decided to check with Lassner at the nearby Monrovia Airport, to learn something of the history of his Ryan S-C. He reminded me that I would get the best information by digging into my own photographic negative files. In 1947, while working with students at the California Institute of Technology in Pasadena, Lassner had made his S-C available for one of the early rain-making experiments with dry-ice. I had taken photographs to illustrate the story.

When he mentioned the dry-icing story, I remembered the ship well, because the performance of the old-time Ryan S-C had surprised me. Lassner had taken off with two passengers and 50 pounds of dry ice and I had flown after him in a high-wing four-placer of post-war vintage (but not a Navion). We couldn't climb anywhere nearly as fast as the old S-C, even though there were only two of us in the post-war plane, and Lassner had to throttle back so that we could catch up with him—even though he had a full load of passengers and freight!

Later, another pilot went to sleep at the controls and washed out the landing gear on Lassner's S-C. He sold the damaged ship to two night-shift workers at North American Aviation, Inc., who are rebuilding it. Paradoxically these North American employees are working on this Ryan at the same time Ryan employees are building Navions, originally designed by North American.

A check with the two new owners of the S-C reveals that they'll soon have it in the air again, ready to extend its twelve-year history for many more years. "Actually," they told me, "the owner of another Ryan S-C we know flew all the way out from New York to try to buy our plane from us—but we won't sell."

SUPER PLANE

(Continued from page 5)

low enough to safely drop blueprints, specification sheets, mail or even payroll.

By three in the afternoon he's back at Grand Island. Once or twice a week he leaves the Navion outside the hangar upon his return, for after dinner he will be flying John L. Hudson or another company official to Omaha to make airline connections to the East. During last fall and winter he made 100 such night flights.

At regular intervals Patterson flies through South Dakota and Iowa to make sure supplies are arriving on schedule and work is progressing satisfactorily. Before the last season finished Hudson bins stored seven and a half million bushels of corn in Nebraska, two million in Iowa and two million in South Dakota.

"It would be impossible for me to carry on such wide-spread operations by any other means than our plane," Patterson is frank to state. "And I wouldn't attempt doing it with any ship but the Navion."

A quick look at the fields he uses tells much of the reason behind his confidence in his Navion. There are some landings, for example, in alfalfa that stands over a foot high. A few fields are only 500 feet between fences. Recently at Plainview, Nebraska his Navion lightly loaded took off against a stiff wind in just 220 feet. Ordinary take-off runs never exceed 400 feet. The Navion's cross-wind performance on rough fields and pastures is for Patterson the final touch of perfection.

Much additional time is logged between Portland, Oregon, and Grand Island. During all his flights Patterson reports he finds it easy to maintain a smooth 170 m.p.h. cruise, and on a recent leg from Boise, Idaho to Grand Island he averaged 182 m.p.h.

Given a super-job to do, Patterson succeeds with a Super plane, and while racking up a construction record for the Hudson Company, gives inspiration and impetus to business flyers everywhere as the first FLYING BUSINESSMAN-OF-THE-MONTH.

GENERAL ELECTRIC COMPANY VISITOR

Acceleration of production schedules on jet engine components for the General Electric J-47 engine was the subject of a conference recently between Ryan Aeronautical Company officials and D. D. Lawson, purchasing agent of G. E.'s gas turbine division.

Lawson came to San Diego from his headquarters in Lynn, Massachusetts, to discuss the project, one of the most important in Ryan's metal products division.

Discussing scheduling, left to right, Fred Coffer, coordinator of customer service; Sam C. Breder, director of customer service; Lawson; and Bob Clark, then assistant to Breder. Clark since has been named assistant production manager.

CUT MASTER

(Continued from page 18)

that, on the basis of first job runs, production on items like the 48-inch aluminum rings for external fuel tanks will be stepped up 25% over previous methods. Similar increased production rates are anticipated on steel cones, aft frames and other jet engine parts.

Emphasizing that a vertical turret lathe is really a conventional turning lathe raised to an upright position, Whetstine adds that he had only to set up a brief training program for his key men to insure skilled operation of the new equipment. Lair also points out that although the Hi Boy is a mighty husky number, its utilization is fatigueless for the operator. One man can run it safely and efficiently, manipulating the lathe's "pendant" (gear control arm) to set off electrical solenoids which in turn hydraulically actuate gear changes to produce desired rotating speeds up to 160 RPM on the fast-whirling table or chuck.

Texan Wins Honors In Flying Contest

Hal W. Harman of El Paso, Texas, a 53-year old executive who learned to fly in 1946 and has piloted 500 hours every year since, has been named FLYING BUSINESSMAN-FOR-DECEMBER by the Ryan Aeronautical Company.

Harman is the second of a series of monthly champs to be announced in the competition which Ryan is sponsoring to determine the American businessmen who log the most hours on their Navions. Awards are also given for the highest hour-total during each three-month quarterly period. A gold trophy will go to a grand prize winner titled FLYING BUSINESSMAN-OF-THE-YEAR.

Bill Mueller, Manager of Southwest Air Rangers, Navion dealer at El Paso Municipal Airport, will present Harman an engraved bronze plaque in recognition of his earning top honors for December.

During the latter month Harman flew more than 91 hours in a Super 260 Navion while conducting business as President of the Harman Process Welding Company. He uses the four-place plane to fly technicians and tools to oil fields, mines, power plants and other heavy machinery installations where his firm's special welding process is used to repair motor blocks, diesel and steam engines. Presently much flying is done to Odessa and Midland, Texas, where fast repairs to broken-down oil drilling equipment mean thousands of dollars saved for his customers.

Such travel requires many landings on rough ground never intended to serve as an airfield. Near Amarillo, Texas, he lands on a stretch of wild prairie adjacent to the Canadian Gas Company's plant.

Says Harman about his rough field operations, "Such maneuvers hold no fear for me as a private pilot. The Navion is plenty rugged enough to handle the tough going, and it is the most stable plane I've ever flown. Even in bad weather conditions and high winds it is so docile it handles like a kitten. I've found it the most honest airplane on the market."

With licenses to use the Harman welding process leased all over the United States, President Harman personally calls on a long list of field offices and licensees. The Navion helps him to perform feats in supervision like completing contacts at Los Angeles, Bakersfield, Fresno and Oakland, California all in a single day.

PLANT TOUR

Unfortunately we don't have the opportunity to show many readers through the Ryan factory, but we can ask you to join us in this column while we go through the plant and meet some of the people who help make Ryan a better place to work.

A DECADE OF SERVICE. Sixteen Ryan employees have joined the ranks of those proudly wearing 10-year pins. They are **Onus Blair, John Dannevik, James Berry, Edgar Leach, William Lowe, Woodrow Gardner, Cecil Hamlet, Aurin Kaiser, Charles King, Joseph Hollis Jr., Arthur Kilmer, John Cameron, Martin Mullins, Ronald Reasoner, Kenneth Wood** and **Ralph McClester.** At presentation ceremonies, **T. Claude Ryan,** president, and (left to right), Hamlet, Kilmer and Cameron discuss model of Netherlands East Indies STM seaplane on which production was under way 10 years ago when they first joined the company. Do you know that more than 10 percent of the Ryan employees have passed the 10-year milestone?

IN CONFERENCE. Eleven key Ryan supervisors recently attended the 1951 regional conference in Los Angeles for manufacturing management men sponsored by the National Association of Foremen. Those attending were **Floyd Cox,** president of the Ryan Management Club, **Gene Wilcox, Darwin Whetstine, Ted Hocker, Don Wilcox, Bob O'Keefe, Wilson Hubbell, Ernest Mellinger, James Moore, D. H. Palmer** and **Ray Sanders.**

ONCE-OVER. Ryan's guided missile program and general plant production were inspected recently by two top-ranking Air Force officers—**Maj. Gen. Pearl Robey,** director of guided missiles projects, and **Maj. Gen. Orville Cook,** director of procurement and industrial planning.

RECORD HOP. Ryan workers got a big boost out of the recent record non-stop flight of a Boeing C-97A from Japan to Hawaii in 10 hours, 23 minutes. The plane averaged 375 mph., and maintained 450 mph. for two hours. The C-97A is equipped with Ryan exhaust systems, and the aft fuselage section is manufactured here.

GRATITUDE. Overwhelmed by the generosity of fellow Ryan employees who contributed almost $500 in a plantwide collection when they learned of his financial plight, **Bill Cole,** of jet assembly, thanked the workers by means of television recently. The collection helped Bill and his wife, Pat, over the hump of steep expenses incurred when their 8-month old son, Larry, had an eye removed to stop the spread of a malignant growth. The Coles and their child appeared on television as guests of **Horold Keen** in his popular "People in the News" program. Keen himself is a Ryan employee, having recently joined the public relations staff.

ON THE "BEEM." A patriotic family is that of Othello Beem, jet assembly spot welder. Two of his six children, Claudette Louise, 20, and Donna Marie, 19, have enlisted in the WAF (Women in the Air Force), comprising San Diego's entire quota for the second half of February. Before leaving for their Air Force training at San Antonio, Tex., they expressed a desire to see dad at work. Accompanying them to the plant was Pfc. Bettie Powell, in charge of San Diego recruiting for WAC's and WAF's. While dad blushed furiously, they observed him on the job (left to right, Pfc. Powell, Claudette Louise and Donna Marie). Beem's oldest child, Milton, 26, of Hartford, Conn. is an Air Force veteran employed in an aircraft engine factory. "That makes four out of eight in our family doing some kind of defense work," says Ryanite Beem, who went to work here last summer, soon after arriving from Mars Hill, Me., three miles from the Canadian border.

TRANSPORTATION

(Continued from page 11)

6,000-pound capacity lift. The job will be finished in half an hour, and Agular will most likely receive his next assignment at the same time he reports by phone from Jet Assembly that his first mission has been accomplished.

Transportation Supervisor Milt Johnston is able to carry out the large share of his department's responsibilities through use of familiar Banty lifts and flat-bottomed Buda "Chore Boys". It's only the big and unusually bulky jobs that demand the services of the Hughes-Kennan crane or the 10,000-pound capacity Electric Automatic Lift. These strong-armed movers most frequently figure into the unloading of ponderous new lathes and the placing of Boeing C-97 Stratofreighter aft fuselage sections aboard rail flat cars.

More specialized duties are assigned a Hebard "Shop Mule", which the Airplane Test Section uses for towing new Navions from Final Assembly to stations along the flight line. Another one-job machine is a Ford-Ferguson tractor employed to pull heavy dies back and forth between the drop hammers and the foundry.

A Tennant Motor Sweeper used by Janitor Service to clean plant streets and aisles in production areas represents a final degree of specialization, as does the fully equipped ambulance manned by Flight Inspection personnel who are on continuous alert against accidents on the runways or taxi strips of Lindbergh Field. Sludge accumulated from the carbides used in Ryan's extensive welding processes is removed from the plant in a 600-gallon tank truck that has this sole duty.

While Transportation is responsible for the maintenance of every piece of company transportation equipment, other departments share the operating load. After materials and machinery have been delivered to production departments, for example, the movement of supplies and materials within the production areas is handled by production personnel using equipment permanently assigned to them by Transportation. Should a job prove too big for the normal-size crew and their fork lifts, then Transportation lends a hand with extra men and larger equipment.

MECHANICAL Maintenance likewise depends upon its own men using permanently assigned cranes and lifts to perform near-miraculous feats of transplanting entire departments overnight. Other departments operating on this same basis include Airplane Service with its Jeep for swift liaison between the Service Hangar and Spares; Inspection, Production, Receiving and Shipping with fork lifts; Janitor Service with Buda Chore Boys and sweeper; Wood Shop; Electrical Maintenance; Final Assembly; and Dispatching. The Engineering Laboratory utilizes the plant's only motor scooter as fast transportation for electronics repairmen. Thirty-five bicycles are assigned to nearly as many departments.

Routine removal of all types of plant refuse accounts for many of the daily entries in Transportation's dispatching log. Sludge from acid tanks, sand blast powder and trash are but a few examples of the refuse from high-capacity modern manufacturing. Salvagable materials must also be properly transferred.

37 96

THOUGH not possessing the infinite variety of equipment and job types as In-Plant Transportation, "Outside Transportation" performs a vital role in keeping factory operations swiftly paced and efficient.

Work horses of this latter division of Transportation are impressive tractors and trailers (in combination, called "semis"); dump, stake and pick-up trucks. These hefty vehicles do a long list of hauling jobs extending from the delivery of B-36 flaps on specially designed racks to Convair, to picking up metal stampings and other bulky materials at supply sources in Los Angeles.

Ryan experimental activities at Edwards Air Force Base at Muroc, California, depend entirely upon Outside Transportation for delivery of heavy equipment, instruments and parts. For personnel travel at Muroc, Engineering has permanent use of station wagons and automobiles. High-priority shipment of technicians and equipment is accomplished in one of the company's own 170 m.p.h. Ryan Navion executive planes.

Airplane Sales, Metal Products Customer Service and the Engineering Unit at Holloman Air Force Base, Alamagordo, New Mexico, similarly use station wagons and cars for commuting and general travel requirements. The Mail Department operates a special panel truck for its many daily trips to the main post office.

One of the most unusual outside transportation jobs is free bus service for employees at the beginning and end of each shift. The plant's own 28-passenger bus shuttles back and forth from the main gate to the principal intersection of up-, down- and cross-town traffic.

Nine other sedans are in steady use by various other departments which conduct outside business. Each day some 25 calls are received by Transportation for their use. In a month's time nearly 40,000 miles are driven on all forms of Outside equipment.

To keep such a fleet of in-plant and outside vehicles in top operating condition, modern shops with crack mechanics like Paul Lane and Jim Berry, both Ryan 10-year men, are needed. Maintenance that includes complete overhaul is performed at the plant garage.

A few hours spent with Transportation's supervisor and his staff will uncover a strange phenomenon one is otherwise unaware of. Though people will usually accept legitimate reasons for occasional delays in most factory operations, seldom will they tolerate anything less than immediate service from Transportation. This quirk in attitude coupled with the broad scope of work to be done exacts a remarkable combination of skill, ingenuity and diplomacy from everyone in this high-pressured department.

CERAMICS FOR THE HOT SPOTS

(Continued from page 1)

ing 377, in which one engine has the collector ring, as well as the header assemblies, ceramic coated.

The problem of heat resistance is greatest in the headers, which comprise those portions of the manifold bolting directly to the cylinder heads of the engine. Gases are introduced first into the headers before they pass into the collector rings. Exhaust gas temperatures are most intense in the headers, cooling somewhat when they flow into the collector rings.

In today's powerful engines, temperature of gases in the headers is above 1900°F., compared with temperatures ranging from 1200° to 1600° F. in World War II. Greater horsepower and higher back pressures through the use of turbo-superchargers are among the factors responsible for producing temperatures exceeding the heat resistance of some of the most expensive alloys.

Under such circumstances, there is need for a high heat resistant but non-strategic alloy to start with. The ceramic coated headers used in the Boeing 377 are built by Ryan of 19-9DL steel, an alloy containing nickel, chromium, tantalum, titanium, tungsten, columbium and molybdenum, a substantial improvement

over the thick ceramic coated low carbon steel SAE 1020 used in World War II.

THE enamel used on this alloy is based on National Bureau of Standards ceramic coating A417, designed for jet engine, gas turbine and other high temperature applications. Specific purposes of the enamel, to prevent oxidation, carbon absorption and corrosion attack have been borne out in the 650-hour and 1200-hour tests under actual service operating conditions.

At the considerably higher operating temperatures of present exhaust systems, much of the rapid deterioration of unprotected headers has been due to high rates of carbon absorption with resulting surface embrittlement. Enameling prevented this carbon absorption, thus greatly increasing the life of the headers.

There was no reduction in gauge thickness (.045") on the header coated on both sides, indicating that the ceramic coating retarded corrosion 100 percent, at least over a 1234-hour period. After 650 hours, only a slight reduction (to .042"), due to scaling on the outside, was noted on the header which was coated only on the inside. Non-coated headers showed some loss in dimensional thickness when used 650 hours.

After fabrication and inspection by Ryan, headers now in production for the Boeing 377 are shipped to the California Metal Enameling Co., Los Angeles, for the ceramic coating process. All parts are sandblasted to provide a uniform finish. Care is taken to assure that the surfaces are free of all contamination so that the ceramic coating will have a maximum bond with the metal.

Slip joints between the header sections are made of alloys with an extremely high oxidation resistance. They must be kept free from ceramic coating where the parts are slipped together. A clay solution is applied by brush to mask these portions. Having no bond with the steel during the firing process, the clay conveniently shatters itself off when the parts cool. The areas coated before dipping are left free for joining purposes.

After any necessary masking, the headers are hung on a conveyor which takes them to the dipper who dips the parts in the special ceramic coating A417 "slip" which, in texture, is similar to thin wet clay.

In making the slip, California Enameling uses a special "frit 331," based on a Bureau of Standards formula. A "frit" is the gravel-like material that results from melting raw materials to form a type of glass, and pouring the molten glass into cold water to shatter it. Then the "frit" and other mill materials are ground to a powder-like consistency and water is added to hold the materials in suspension.

After the dipping process, the "slip" is drained from the headers, leaving an extremely thin coating, of approximately .0015" thickness on both interior and exterior. The parts then are beaded to remove any build-up of ceramic coating along the downward edge.

Another conveyor carries the headers to firing in a special high-temperature, V-bottom furnace, 12 feet long, 5 feet wide and 4 feet high. The parts are hung from heavy Inconel hooks and frames, and fired for approximately 12 minutes at 1850° F. accurately controlled as to heat and time.

When the parts are removed from the furnace and allowed to cool at room temperature, the clay masking shatters from the coated slip joint and flange surfaces. The other portions have a smooth, green enameled surface.

The nominally higher cost of ceramic coated headers will be more than absorbed by extending the life of the exhaust system, it is reasonable to believe from the results of the tests to date.

MUCH research is being conducted by industry, technical schools and by the Air Force on use of ceramic materials for various applications. In addition to exhaust systems, these include combustion chamber liners, rotor buckets and stator blades for gas turbines; rocket motor components; walls of ramjet and pulse-jet engines, heat exchangers, and coatings for skins of supersonic vehicles.

At Ryan, the key men in Operation Ceramics, are Foushee, Hacker, Wilson G. Hubbell, chief metallurgist, and Ralph Haver, manifold design specialist.

Additional study is inevitable before even the partial potentialities of ceramic materials are realized. Meantime, this centuries-old art is being put to practical use on such projects as Ryan's exhaust collector systems for the Boeing 377 Stratocruiser, and on future exhaust systems for Boeing B-50 bombers and C-97 military transports.

87 96

Navion Helps Capture Public Enemy

One of the biggest manhunts in history was brought to a successful conclusion in mid-January, when a 1951 Ryan Navion Super 260 landed at the Agua Caliente, Mexico airport.

In the plane was the man peace officers of two nations, Mexico and the United States, had been hunting for more than a week—sullen William E. Cook, Jr., 23-year-old Missouri desperado suspected of murdering eight persons.

On Friday night, Jan. 12, Police Chief Francisco Kraus Morales of Tijuana received a tip that Cook and two American prospectors he had kidnapped, were somewhere along the west coast of Baja California.

Gov. Alfonso Garcia Gonzales of the northern district of Baja California immediately volunteered the use of his recently purchased Ryan Navion. The next morning, Police Chief Kraus Morales and an assistant took off in the Super 260 Navion, with the governor's personal pilot, Jose Navarro Macias, at the controls.

The plane landed at small fields near settlements along the coast, tracing the route of Cook and his prisoners. On Sunday, Jan. 14, Cook was cornered in a cafe at Santa Rosalia, 600 miles below the border.

His wrists securely manacled, he occupied the fourth seat in the Navion on the return trip.

RYAN AERONAUTICAL COMPANY
LINDBERGH FIELD
SAN DIEGO 12, CALIFORNIA

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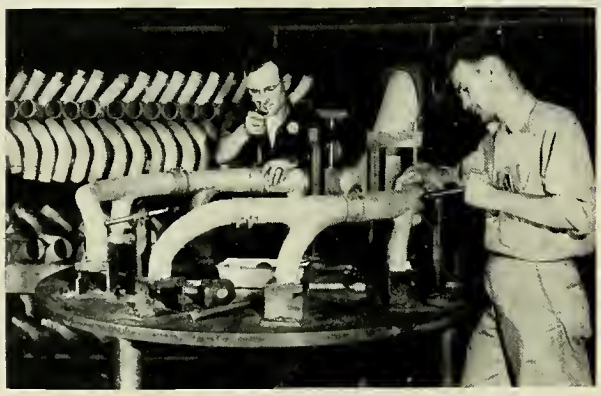
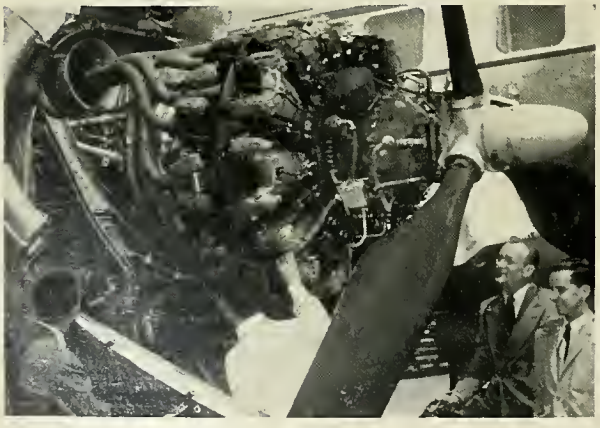
EXHAUST SYSTEMS SERVICE... ..."nothing short of a miracle"

"Twenty-four hour service . . . in fabricating and delivering these exhaust systems is NOTHING SHORT OF A MIRACLE." That's how Ryan's on-time performance was described in an unsolicited statement by an engineering executive of a leading aviation company. Actually, it's the logical result of Ryan's unique 3-step service.





1. ENGINEERING AND DESIGN CONSULTATION

Call on Ryan for technical assistance *in the design stage* of your project. It will result in weight saving, assure superior performance and service, and save precious engineering time. Our technical people are immediately available *anywhere* to service the Air Force, Navy and all airframe, engine and guided missile manufacturers.

2. SUPERIOR PRODUCTION EXPERIENCE

Ryan has been foremost in making the design and production of exhaust systems a specialty in itself and is today still the only manufacturer with the "know-how" which comes from also designing and building complete aircraft. Ryan Metal Products are standard on many of America's most successful commercial military planes.

3. FOLLOW-THROUGH SERVICE

So that Ryan manifolds may give the fine service of which they are capable, our service department has been staffed with specially trained personnel. These men are always available to Ryan customers. Take full advantage of Ryan's *engineering* leadership, advanced *production* techniques, and *service* experience in high-temperature metallurgy.

RYAN Metal Products

DIVISION OF RYAN AERONAUTICAL COMPANY • LINDBERGH FIELD • SAN DIEGO, CALIFORNIA

Ryan REPORTER

VOL. 12, NO. 3

DASH

by K. F. Houseman

EQUIPPED with an afterburner for greater thrust, the "dash seventeen" is General Electric's newest production model of the basic J-47 jet engine. As with previous models, sub-contractors will be extensively used by GE to assist in the mass production of major components of this newest engine.

Assembly of complete engines from components built by sub-contractors like Ryan, which produces exhaust cones, combustion chambers, transition liners and other parts, is accomplished at GE's new Lockland, Ohio, plant. This plant represents a new concept in production. Several hundred manufacturers in 26 states make parts for the J-47 and ship them to Lockland. In the case of some parts, two or three sub contractors make the same components, assuring a constant flow of the needed parts for continued production.

The addition of an afterburner to the J-47 is, of course, only part of the story of the vast improvements which are being incorporated in the "dash seventeen" production model. It is an "all-weather," completely anti-iced engine; it is fitted with automatic electronic controls and automatic starting, and it is being built with major reductions in strategic materials.

The "all weather" engines are designed to overcome what has been a knotty problem in jet operation. Supercooled water droplets, striking the air inlet at the nose of the engine, form into ice crystals and within seconds can block passage of air into the engine. If this happens, pilots have to cut off power immediately.

GE engineers overcame the icing problem by giving their engine "hot noses." Hot air from the engine's compressor is bled to hollow parts, including the air inlet guide vanes, fairings and support struts. Ice crystals are melted before they can endanger the engine. In addition, the air inlet screen — designed to keep foreign objects from passing through the engine on the ground — has been made retractable. The screen, the basis for potential ice "dams," is retracted once the plane is airborne.

These "anti-iced" engines make possible the successful completion of missions under severe icing conditions. They also have special ignition systems which make possible starting the engines at altitudes up to 50,000 feet.

The J-47-GE-17 engine equipped with afterburner will power the North American F-86D Sabre interceptor. The basic J-47 engine, which is the number one production engine of the Air Force, also powers the six-engine Boeing B-47 Stratojet, the North American four-jet B-45 bomber and the intercontinental Convair B-36 to which four jets have been added in latest models to provide greater power for take-offs and high-

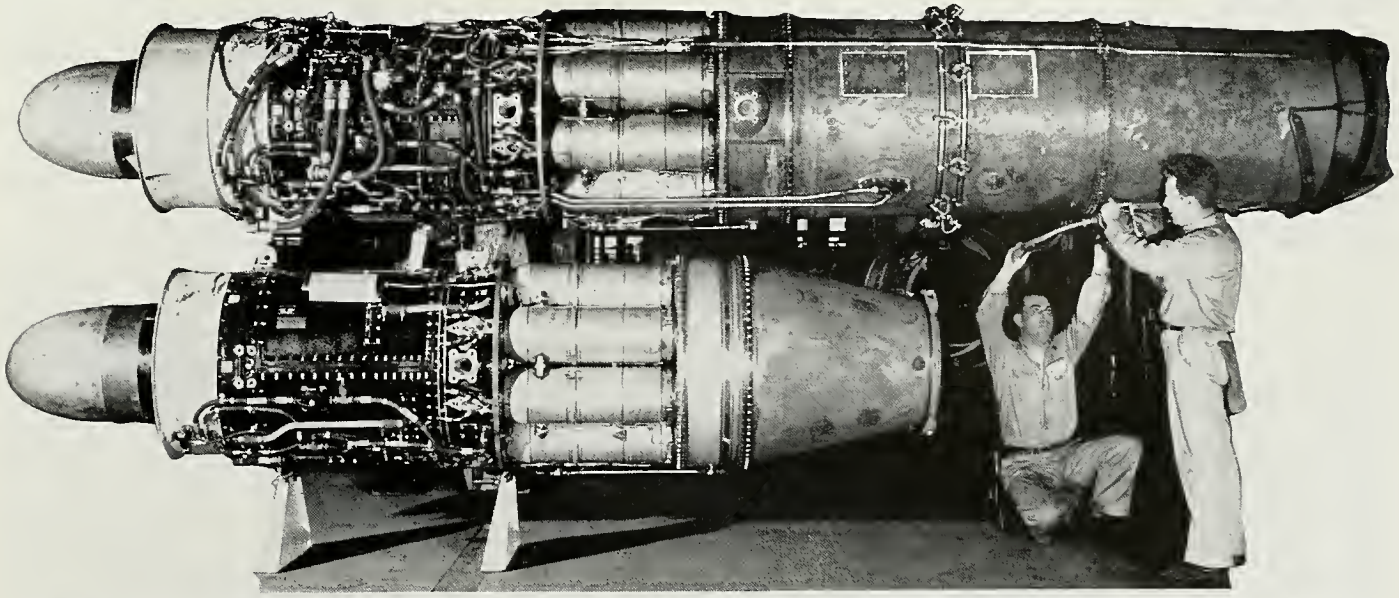
(Continued on Page 18)

Exhaust cones, one of G.E. J-47 jet engine components made by Ryan, present cannon-like appearance in test runs at Lynn, Mass.

Ryan Aeronautical Company builds numerous component parts of the J-47 turbojet engines. Production scene in Ryan plant shows inner and outer cones, combustion chambers, transition liners and struts.

SEVENTEEN

lanager, Lockland Plant,
Aircraft Gas Turbine Divisions, General Electric Company



The "Dash Seventeen," elongated General Electric jet engine at top, provides "Sunday punch" for Air Force planes. It burns additional fuel in tailpipe, increasing driving force of the engine, which is compared with standard J-47 turbojet, below.

U. S. Army Photograph

At a roadway airstrip somewhere in Korea, an L-17 Navian liaison plane comes in for landing from a fighter direction mission.

BIRD DOGGING IN KOREA

by Major Michael J. Strok

as told to Adie Suehsdorf

You don't have to be Superman to fly one of the Army's "bird dog" planes -- but it helps

Michael J. Strok, pictured at right with T. Claude Ryan, president of the Ryan Aeronautical Company, saw 30 months action in Africa, Sicily and Italy during World War II. Among the first of the "Army Aviators" he was assigned to Wright Field after the war in maintenance and procurement divisions, and later as Department of the Army liaison officer to Air Materiel Command. This account was written after recent return from Korea on temporary duty observing Ordnance Aircraft Maintenance organizations in combat support. The Army Ordnance Corps is now responsible for maintenance and supply of Army aircraft in a manner similar to guns, tanks and vehicles.

THERE'S a special little band of flyers in Korea known as Army aviators, and I'm convinced they can do anything.

That's a big statement. But these are very unusual guys. I'm just back from a month of watching them, living and flying with them, and I know.

I'm not talking about Birdmen; that's the Air Force crowd. These are members of the walking army who have been trained to fly airplanes on a wide, weird variety of missions in direct support of the ground troops. They drive the slowest, smallest aircraft we have, and their jobs almost always call for skill, imagination and a lot of nerve. For instance. . .

At dusk one evening, north of Taejon, one of these aviators was patrolling the

Reprinted from THIS WEEK Magazine. Copyright 1951 by the United Newspapers Magazine Corporation.

First Cavalry Division front in an L-17, (Ryan Navion—Ed.) an unarmed, half-pint cousin of the F-51 fighter. On the North Korean side, he spotted an enemy column, led by two T-34 tanks, preparing to attack. On his radio he whistled up some help from the Air Force and indicated the target.

Winging high and fast in the dim sky, the five F-51's couldn't get a fix. "Calling Picklebarrel One," they radioed. "Cannot — repeat — cannot see target. Over."

"Okay," said Picklebarrel. "Follow me."

Nosing his little plane over, the aviator dove at the tanks. He dropped his flaps, turned on his landing lights and held the target in their beams. The frantic Koreans tried to shoot him out of the sky with rifle and machine-gun fire, but he coasted down until the fighters went screaming past him and made their strike. The Korean attack was, as they say, "chilled off."

Directing Air Force fighter planes onto targets like this is called "bird dogging" and is one of the aviators' primary functions. There are so many others, however, that the flyers themselves say they are in "The Army aviation business," which seems to be the only term that's broad enough to cover their field.

U. S. Army Photograph

Gen. B. E. Moore arrives at Chonan airstrip to visit command post. L-17 has pulled off to road side.

The businessmen are all officers, all volunteers, mostly artillerymen. There are only about 200 of them, and they are parceled out in small units to various Army ground forces. They must meet Air Force physical standards, but any other resemblance to the AF is coincidental. They are strictly the infantry's air power, working with and for it alone. Hence, the old-fashioned name "aviator," and the formal designation of their aircraft as "aerial vehicles."

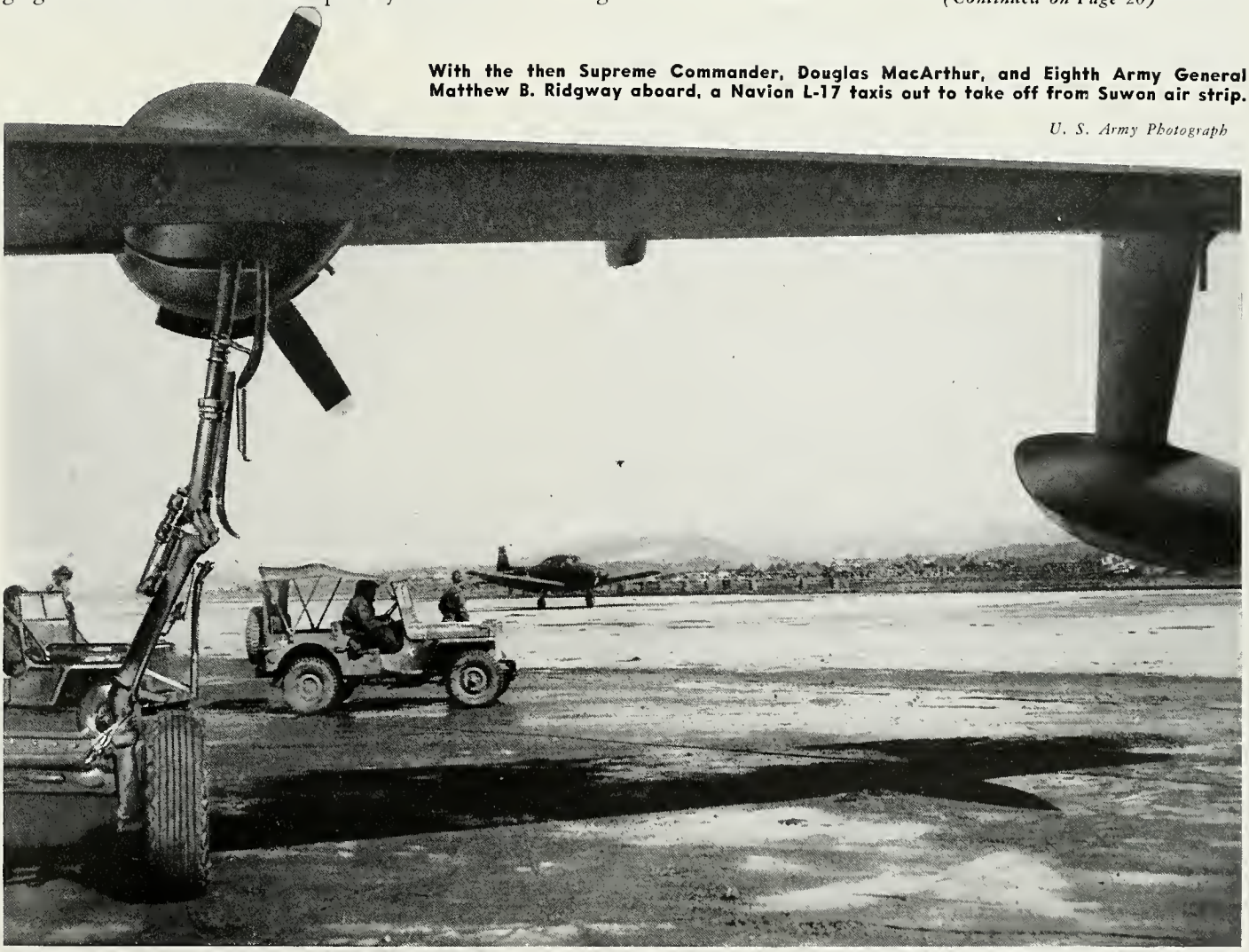
It all sounds a little silly, but it keeps the division between the services clean and clear. The Army's L-4's, L-5's, L-16's, L-17's and helicopters—all observation-reconnaissance planes—are simply considered to be jeeps that can fly. Like jeeps, they are slow and unarmed. Speed only hinders an observer poking about for weak spots in the enemy's zone. And armament is out of place in a plane not designed for fighting.

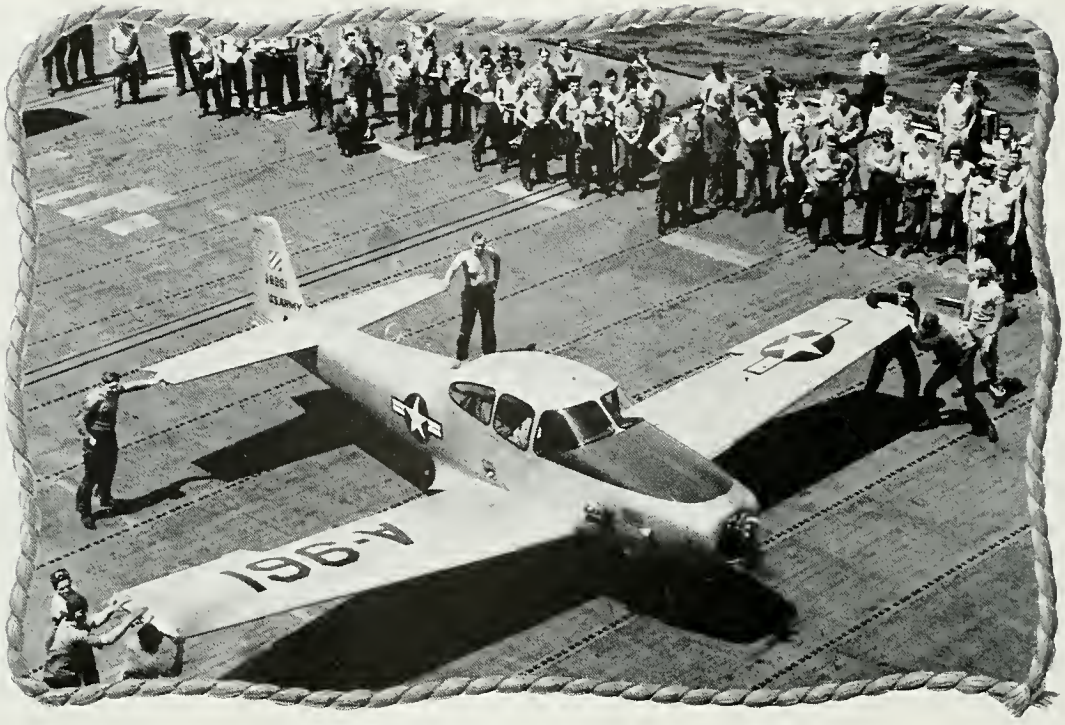
The characteristics of the little planes explain a lot about the aviators. Only someone who figured he was flying low and slow in a jeep would, for example,

(Continued on Page 20)

With the then Supreme Commander, Douglas MacArthur, and Eighth Army General Matthew B. Ridgway aboard, a Navion L-17 taxis out to take off from Suwon air strip.

U. S. Army Photograph





Official Photographs U. S. Navy

During "Operation Portrex" last year in Caribbean maneuvers, Capt. W. Pauly of Army Field Forces takes off in Ryan Navion L-17 from the deck of aircraft carrier "Leyte."

Sea Going L-17

WE'VE always been proud of the fact that our escort carrier, the USS Badoeng Strait, could perform the unusual whenever necessary. So it was with a great deal of satisfaction that our crew assisted in the first combat operational takeoff from an aircraft carrier of a Ryan Navion L-17B liaison plane off the Korean coast.

It was a tense moment, of course, but the operation took place without a hitch. Even under the most favorable circumstances, the first aircraft carrier takeoff for a Navy pilot is a suspense-filled occasion. You can imagine, then, the mental reservations of an Army Field Forces officer as he prepared for a carrier takeoff in a liaison plane never designed for seagoing duty.

The L-17B, personal plane of Maj. Gen. Edward M. Almond, commander of the 10th Corps, comprising the First Marine Division and the Seventh Army Infantry Division, was hoisted aboard the USS Badoeng Strait at Sasebo, Japan. It had been used extensively by Gen. Almond for transportation around the greater Tokyo area.

The L-17B was accompanied by Gen. Almond's personal pilot, Capt. William B. Capps, who was given the assignment of effecting a rendezvous with the general ashore, if possible, following the amphibious landings at Inchon. That meant a takeoff from the carrier, and Capt. Capps was no little concerned.

In our conferences with him, our officers did their best to reassure him. We felt confident that he would have no difficulty getting the Navion off in the carrier's 550-foot deck length and proceeding to his destination. I had a personal interest and reason for confidence because I had been the Bureau of Aeronautics Resident Representative at the Ryan factory several years ago. I'm afraid, though, that our assurances didn't completely eliminate that "guinea-pig" feeling that Capt. Capps must have had as he anticipated the takeoff.

About two days after the Inchon landings, the Navion was loaded, and Capt. Capps stepped into the cabin with our good wishes. We reiterated our previous expressions that there was nothing to worry about, but he seemed rather dubious about the whole venture.

Our confidence in his ability and in the Navion was not misplaced. With a 29-knot wind blowing across the deck, the L-17B made a beautiful takeoff in about 300 feet. It was airborne even be-

(Continued on Page 21)

by Commander E. H. C. Fredericks,

Executive Officer, USS Badoeng Strait

They Learned About Missiles

Wraps are temporarily removed from confidential project, creating Salvador Dali-esque impression.

AS part of the final phase of several months' instruction on guided missile research and development, 50 officers of the Air Force, Army, Navy, Royal Air Force and Royal Canadian Air and Royal Canadian Air Force recently visited the Ryan plant.

The officers, students in the armed services Guided Missiles School at Fort Bliss, Texas, were in San Diego on a practical experience schooling which has taken them into many of the aircraft factories working on guided missiles and in allied fields.

At Ryan, the all-day session directed by 13 Ryan engineers included laboratory

(Continued on Page 21)

Guided missile officer students are given latest information by W. S. Cockrell, expert in this field.

Officers are dwarfed in cavernous factory building at Ryan as they inspect XQ-2 target and secret projects in various fields of research.

Oil Doctor's

WOULD you think of looking for oil with an airplane?

Dr. E. W. K. Andrau did, and his thinking turned up an oil field that helped establish him as one of the important producers of the United States.

BULLETIN. As Ryan Reporter goes to press, Dr. Andrau has been declared winner of the Flying Businessman-of-the-month Contest for February. During that month he logged more hours on his Ryan Navion than any other owner in the United States. He will be presented an engraved bronze plaque emblematic of his victory.

It was in 1940 that he first tried the air-search method. Flood-drenched land in lower Louisiana seemed a promising location for petroleum deposits. As a Doctor of Science in Geology, he was

When supplies are needed during harvest at the rice fields on Andrau Farms, owner Dr. E. W. K. Andrau (standing in cabin) quickly flies them from Houston in his Navion, lands on narrow road alongside harvesting machinery. Similar deliveries are made to his oil drilling rigs.

Divining Rod

familiar with certain idiosyncracies in the earth's surface which mean there's probably oil beneath.

So, getting hold of an airplane, he flew low over the suspect area and readily spotted the points where oil could be best expected. The flood waters gave the terrain a helpful relief map effect. Only recently he followed the same procedure to pick out another rich Louisiana field.

So dramatically successful in this early use of a plane, it's easy to understand why Dr. Andrau soon obtained a ship of his own—an all-metal Ryan Navion—and put it to work in connection with his many business ventures.

Besides his extensive oil holdings, he has a 1,500-acre rice farm near Houston, Texas. Here he spends most of his time, leaving at intervals on inspection trips to his drilling rigs and his cattle ranch in Wyoming, which is business interest No. 3.

Add "airport owner" to his titles of oilman, farmer and rancher, and you have a complete description of this air-minded man's business activities. For adjacent to his rice farm he has built the Andrau Airpark, a private airfield complete with two-direction runways and seaplane base.

Such remarkable versatility and sagacity might seem a bit incredible ordinarily, but not in a man like Dr. Andrau who has enjoyed a fabulous life that began in Sumatra and included ditch-digging in California and engineering in Asia before his emergence as a Texas-Louisiana oil magnate.

"I prize safety above all," he says about his flying. "I take my wife and three children with me a lot. That demands a plane that can be depended upon. With a family our size, we appreciate our ship's roominess, too. And, I consider the Navion the only 4-place plane with sufficient cargo space to permit full utilization of its maximum weight allowance."

When he decided to go abroad last year, Dr. Andrau arranged to travel Western Europe in a Ryan Navion owned by Anco, the Navion distributor for that continent. This way he was able to see much more than would customarily be possible for an American tourist in the time he had available.

Right now he's combining business with pleasure and having more success than ever as he travels the U.S.A. in a handsome 1951 Super 260 Navion which he personally picked up at the factory shortly before the new year.

Last summer at Schiphol, Amsterdam, Holland, Dr. Andrau and a Ryan Navion he chartered from Anco, European Navion distributor, shared runway space with a Stratocruiser of the American Overseas Airlines. This was only one of a host of interesting experiences he enjoyed in a Navion tour of the continent. Back home he's a leader in Texas' civil air defense program.

MET

In the blinding glare of an electric arc this Ryan welder is using the metallic arc method to weld a collector ring for the exhaust system of a large aircraft engine.

THE man behind the metallic arc welder's mask holds the world's hottest fire in his hand. In his everyday work he performs a job which would have been called "metal magic" just a few years ago. Seldom has a tool been developed which is so powerful, so versatile and yet so easily used as metallic arc welding. Practically unknown at the turn of the century, this method for joining metals has made tremendous strides since World War I to attain top importance as one of industry's most useful tools.

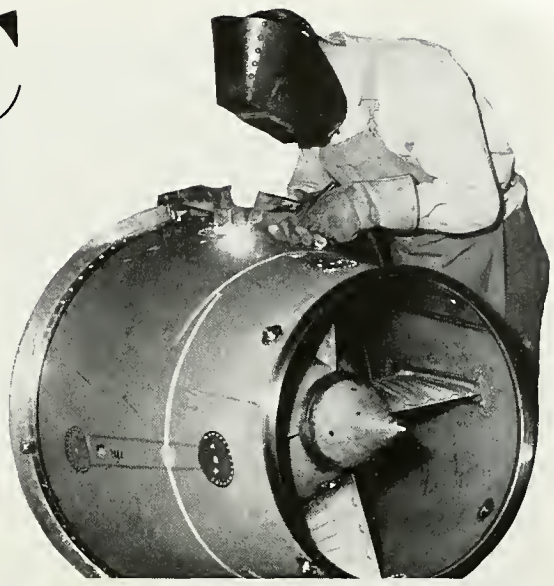
Ryan's extensive use of this modern technique is evidenced by the fact that it is one of the nation's largest consumers of stainless steel welding electrodes. Miles of the metal rods are used each month in the production of Ryan exhaust systems and jet engine components. Sixty percent of the welding tasks on these structures is accomplished by the metallic arc method.

The process involves the flow of electric current between a metal electrode and the parent metal parts which are being joined. The developed electric arc supplies fusing heat which melts the edges of the metal parts and the electrode. These blend into a pool of molten metal which cools, hardens and thus welds the parts together. The welding rod is coated with a flux which decomposes from the heat of the arc into gases and slag. Being lighter than the molten pool, the slag quickly rises to the top and extends a covering over the deposit which protects it from the oxygen and nitrogen of the atmosphere. As the flux melts from the rod, it also shields the arc thus tending to steady it and protect the filler metal while enroute from the rod to the deposit.

Metallic arc welding is a favorite technique at Ryan because it is fast. The arc is struck — metal is deposited and the joint immediately starts to form. The arc moves on — fusing the metals and

AL MAGIC

Electric arc welding is a favorite at Ryan for tough, critical welding jobs



U. S. Terrell of Ryan Jet Engine Assembly secures inner cone within the outer cone of General Electric J-47 jet component with the high strength metallic arc process.

depositing rod as it goes. A minimum of time is required, so that the heat does not build up in the areas adjacent to the weld.

Metallic arc is employed in the manufacture of General Electric J-47 tail cones and of tail-pipes which Ryan is currently producing for the jet engines of the huge Convair B - 36 Intercontinental Bomber and the Boeing B-47 Stratojet. The powerful jet engines of these aircraft are flying furnaces in which Ryan components must work in a hurricane of 1500 degree heat. This blasting environment "torture-tests" every seam and joint with the thoroughness of a testing laboratory.

A critical component in these power plants are the thick-walled positioning tubes which secure the inner cones within the outer tail cones. They carry a great stress responsibility and must fit snugly against the outer cone facing. Metallic arc welding is successfully used to attach the thin caps to these tubes and to secure them in the cones. All of the welds must be perfectly made, without pinholes or craters, in the first welding pass so that re-welding is avoided. The smooth, compact deposit of the metallic arc process is ideal for meeting the high requirements of this type of work.

The high speed of the metallic arc method is extremely desirable for the fabrication of the corrosion - resistant steels because its speed eliminates the adverse effect which sustained temperature and heat-build-up have on these metals.

The unstabilized chromium-nickel alloys are susceptible to harmful carbide precipitation at certain temperature. The critical temperature range for the 18-8 type of stainless steels is between 800° and 1500° F. Within this band of temperature, the carbon separates out of the metal and unites with the chromium to

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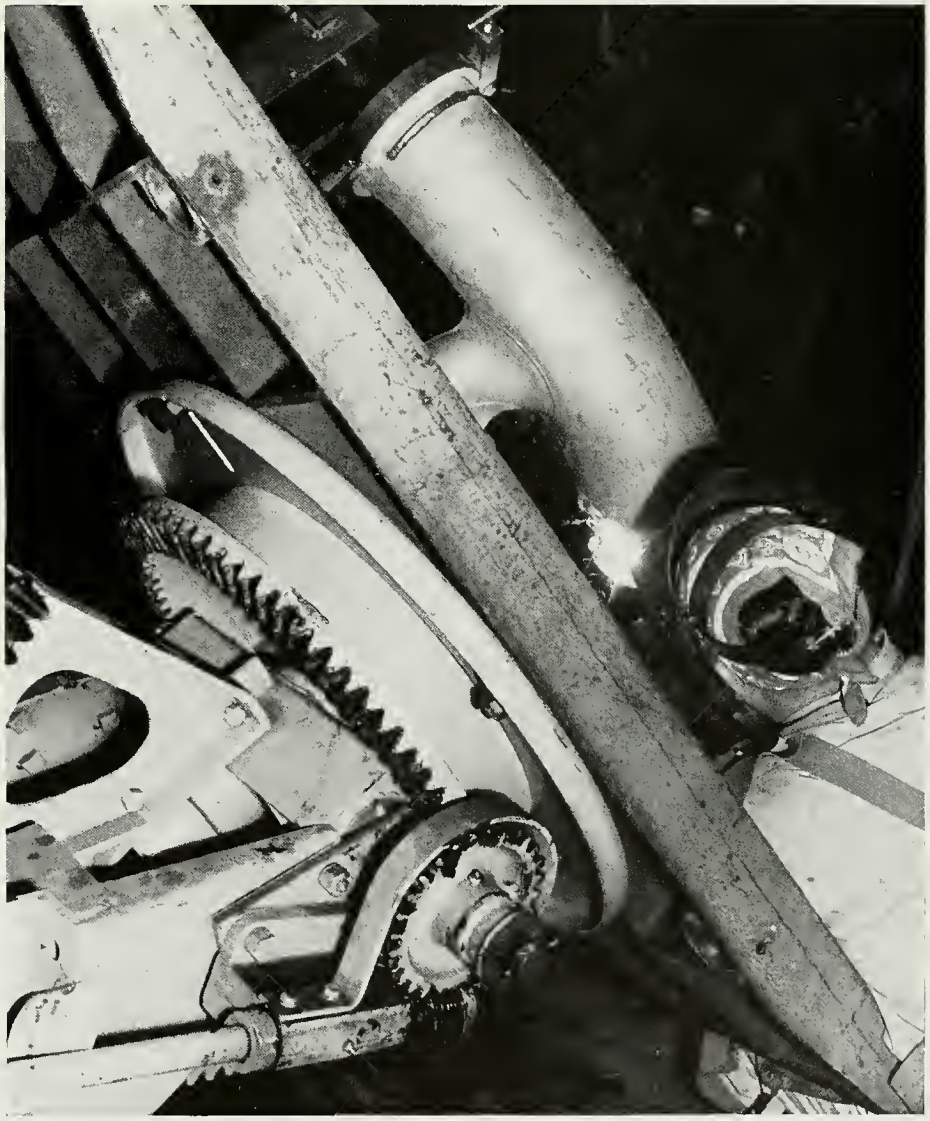
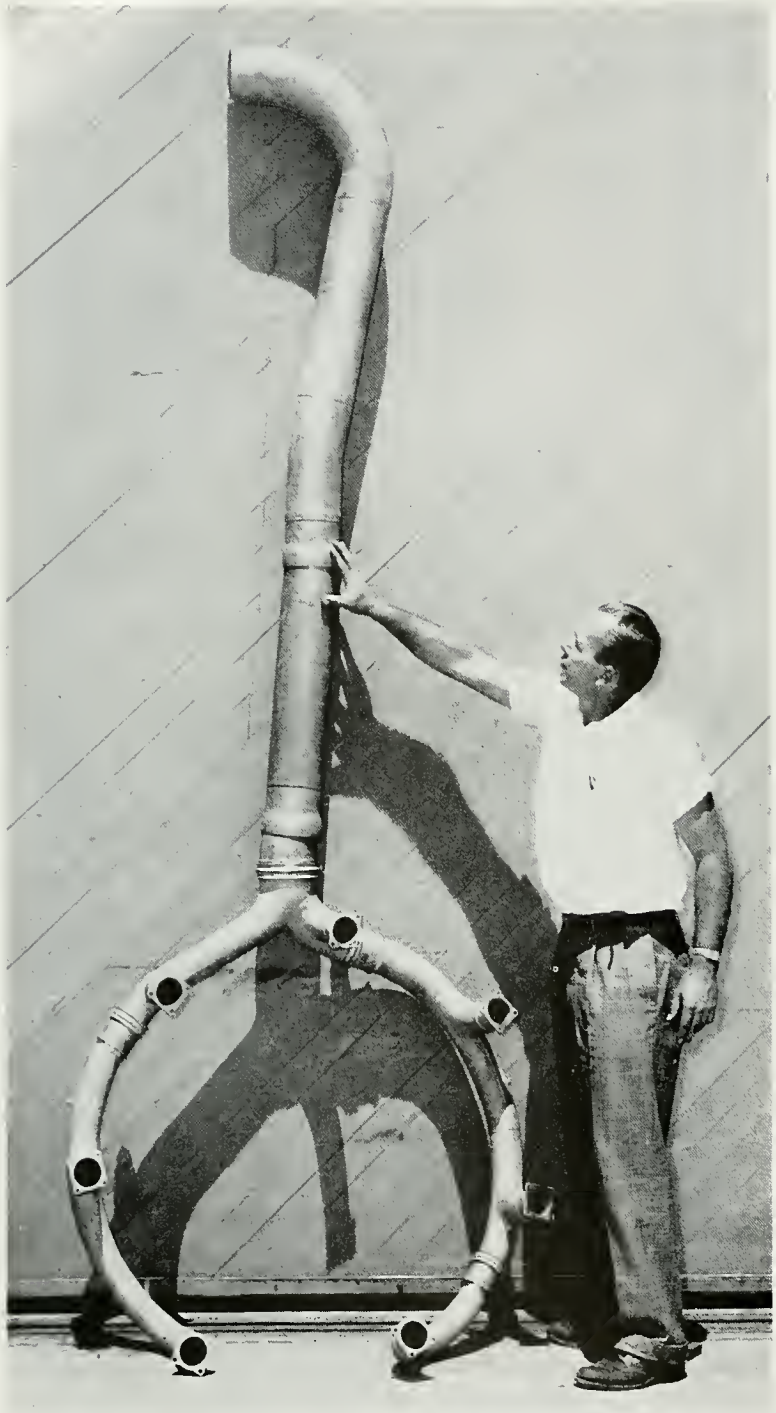


Light weight and compactness of metallic arc electrode allows Ryan welder George Lane to reach most inaccessible area of C-97 manifold. Note ingenious positioning table.



Collector ring and long tail pipe of Ryan exhaust system for the seven-cylinder Wright Cyclone 800 h.p. engines which power Goodyear airship are inspected by Robert Chase, foreman of Manifold Development Dept.

BEST known as standard equipment on leading military and commercial aircraft, Ryan exhaust systems are also used on combat tanks, trucks, locomotives and other transport vehicles. One of the lesser-known aircraft types which use Ryan exhaust systems are lighter-than-air ships, and the newest of these is the Navy's Goodyear ZPN.

Unlike the headline writer who facetiously conceived the Goodyear ZepPeliN title for this article, ZPN is not an abbreviation for the rigid airship type of World War I but the identification of the Navy's newest non-rigid "blimp," the successor of the Goodyear "G," "L," "K" and "M" types.

Construction of this new weapon for the U. S. Navy's modernized anti-submarine warfare team is well under way in factories of the Goodyear Aircraft Corporation at Akron, Ohio, where the big non-rigid airship was designed.

This newest Patrol Airship will incorporate the Navy's latest developments adaptable to such aircraft for the purpose of locating and cooperating in the attack and destruction of enemy submarines, particularly snorkel subs, in the event of future war. The total time for design and construction of the craft will approximate two years.

The N-ship is 324 feet long and its envelope will have a capacity of 875,000 cubic feet of helium gas. This compares with 310-foot length and 725,000 cubic feet capacity for the "M"-type naval airship that currently holds the world's sustained flight record without refueling, and 456,000 cubic feet for the 253-foot "K"-type ships, of which more than 130 were used in anti-submarine warfare service by the Navy in World War II. Both the "K" and "M" ships used Ryan exhaust systems.

Power plant for the new N-ship will be two seven-cylinder Wright Cyclone 800 h.p. single row engines, mounted in an engine room within the control car. Each engine can drive two 18-foot, three-bladed, Curtiss Electric, full-feathering

GOODYEAR ZepPeliN

controllable pitch reversible propellers mounted on outriggers projecting from each side of the car. A series of shafts and gears will transmit the power to the propellers, and, when desirable, one engine can drive both. Both engines are accessible for maintenance and repair in flight, if necessary.

Ryan fabricates exhaust systems for both the ZPN and ZP2M version blimps from welded corrosion-resistant steels, type 347. Designed for quick assembly and easy removal, these sturdy manifolds are built in four segments which are clamped together, with Ryan-designed clamps, to form a collector ring. Each cylinder exhausts its hot gases into the collector ring which funnels them to the atmosphere, outboard of the airship. Thermal expansion of the collector ring is accommodated by special slip-joints which permit the ring circumference to change with temperature fluctuations.

Because this type of aircraft is intended for slow speed flight, necessitating idling engine operation, a source of carburetor heat is most desirable. Ryan has provided this by designing a close-fitting steel

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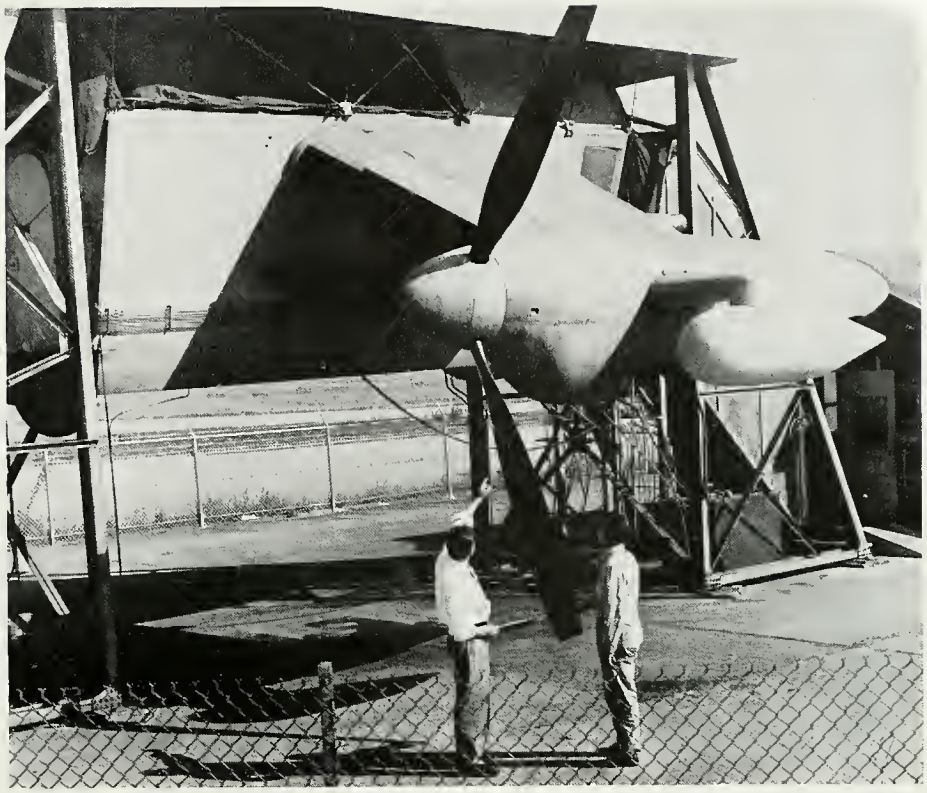
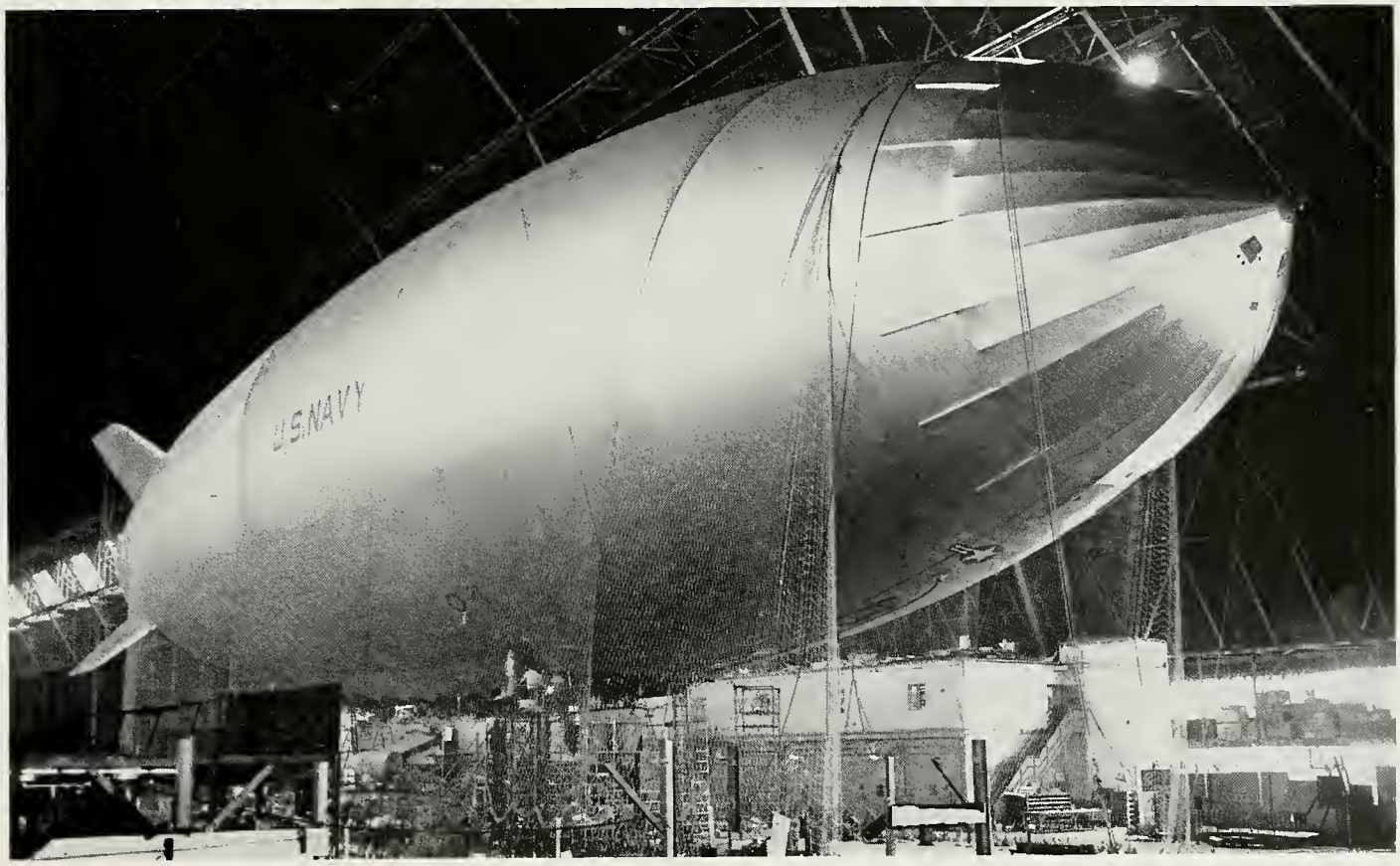


The two 800 h.p. engines for the ZPN airship are mounted in the engine room within the control car and drive two 18-foot, three-bladed propellers mounted on outriggers projecting from each side of the car. Shown here is engine test set up at Goodyear.

The net shrouding the U. S. Navy's new non-rigid airship is used to hold the helium-filled envelope down while the control car and other fixtures are being attached as the N-type ship nears completion in Goodyear Aircraft Corp.'s hangar at Akron, Ohio.

Official Department of Defense Photo



Special conveyors move Ryan shipments swiftly from scales to loading zone where an electric escalator lifts them to trucks.

signed, sealed and SHIPPED

Widely varied transportation is available to the shipping activity. Here jet cones are moved from Production to the packing area aboard an "in-plant train."

HELLO Sam? This is Jimmy Stalnaker in Seattle. Boeing has to have those manifold spare parts by tomorrow morning. They have a plane leaving Los Angeles in a few minutes to pick them up."

A call like this from Ryan's representative at the Boeing plant to Customer Service Director, Sam Breder, asking for unusually fast delivery on an order, starts a chain reaction that has as its final result "service as requested," providing another reason for the Ryan Shipping Department's fast-growing reputation for dependability.

The Seattle message is relayed from Customer Service to Shipping Supervisor Art Selness who quickly sets in motion the men and machinery for gathering, packing and loading the rush shipment.

In successfully meeting such high-priority requests, while servicing myriad regular assignments, the shipping facility reflects the complexity and fast-change that are so characteristic of the aircraft industry. As much ingenuity and planing, it may be safely said, must go into related operations like shipping as into the actual production of planes themselves.

A quick look at several of Shipping's current duties helps explain why its functions are aptly called tailor-made to each new assignment.

Shipping exhaust manifolds, for example, is a special field in itself. Received on schedule from Production,

manifolds are first accumulated in practical shipping quantities, then sent through Inspection (Ryan, Air Force, Customer). Next, a crew of specialists, operating with modern tools and facilities, packs the manifolds securely to insure their reaching the customer in the same grade-A condition they leave Inspection. All experts, they've been well schooled against the under-and over-packing hazards which sometimes plague shippers.

The packers are also trained to appreciate their handicraft as an important feature of the company's public relations effort. They're acutely aware that the neat appearance of their shipments adds polish to the final product, can leave telling impressions on customers.

When the packers wind up their work, stencil artists address the shipping cases according to directions which most customers provide in the "routing instructions" that accompany their orders. In some instances, as with Air Force or-

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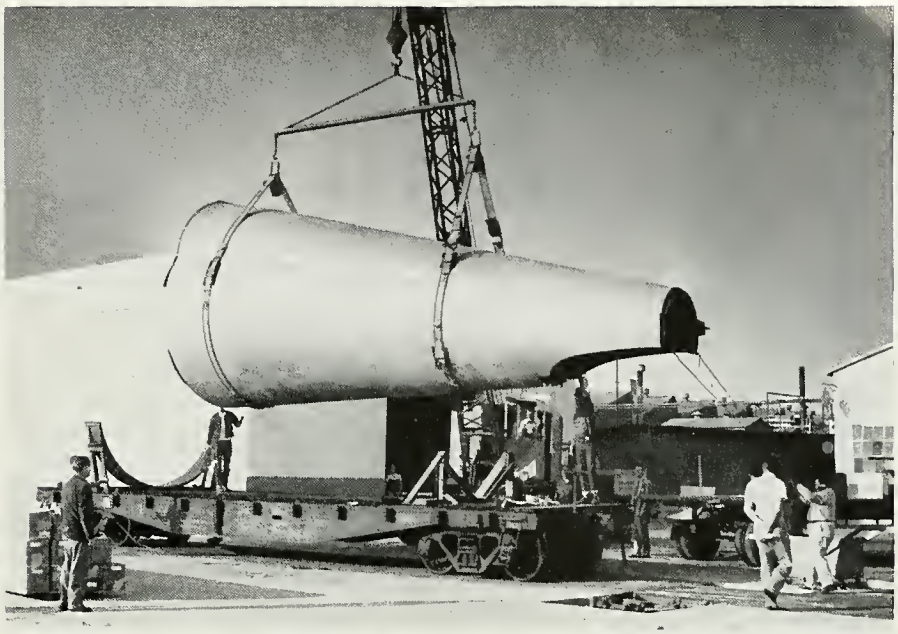


Lifting Stratofreighter fuselage sections into place aboard railway flatcars demands the muscle of big cranes and finesse of highly-trained shipping personnel.

Orderly stocking of manifold parts in spacious storerooms is an important factor in Shipping's efficient operations.

Flying Businessman Winners

Contractor Named Quarterly Champ

GRAND ISLAND, NEBRASKA. George S. Patterson (center) construction superintendent for the John L. Hudson Company, coast-to-coast builders of pre-fabricated structures, was this week named "Flying Businessman-of-the-Winter Quarter" by Ryan Contest officials. With Company President John Hudson (left), Patterson went by Navion to the Ryan plant in San Diego to receive his silver plaque from T. Claude Ryan.

Patterson's total of 194 hours and 45 minutes for the off-season winter months of November, December and January earned him this first of four quarterly "Flying Businessman" prizes. His victory places him in an advantageous position for copping the gold trophy which will go to the "Flying Businessman-of-the-Year" next November.

Flying a Super 260 Navion from his Company's offices in Grand Island and Portland, Oregon, Patterson covers the territory from Nebraska to the Pacific Coast coordinating operations at scores of widely separated job sites.

Northwest Aviation Sales, Inc., in Portland, delivered the Navion to the Hudson Company last October.

Indianan Takes January Contest Prize

INDIANAPOLIS, INDIANA. S. D. Murphy, President of the Mouldings Division of Thompson Industries, Inc., has been announced the January winner of the Ryan Aeronautical Company's Flying Businessman-of-the-Month Contest. His flight time was 81 hours and 6 minutes.

The Mouldings firm, which specializes in the manufacture of fine chrome trim for automobiles and refrigerators, has a second Navion in use for its sales department and a third for operations in the Southern States. All of Murphy's time was logged by him personally on one Navion.

"We don't consider the use of our planes as an unusual procedure," he explains. "Whenever we have anywhere to go we never think of using any other transportation, whether the distance is 75 miles or 750 miles. We simply consider the Naviens as very worth while additions to our stock of business machines. They have increased our efficiency and our ability to give better service to our customers."

Don Hood, Navion dealer in Indianapolis, was in charge of ceremonies at which Murphy received his award.

Texans Honor Dec. Flying Businessman

EL PASO, TEXAS. Civil, diplomatic and military dignitaries, business leaders and aviation officials turned out in equal numbers with lifetime friends recently for a luncheon at the El Paso International Airport honoring Hal W. Harman, winner of the Ryan Flying Businessman Award for December. Mrs. Harman in company with several of the distinguished guests is shown with the plaque presented to her husband, who stands at her left.

Harman, 53-year old inventor and president of the Harman Process Welding Company, flew 91 hours and 30 minutes during the last month of 1950 to be named the "Flying Businessmon." First learning to fly in 1946 when his patented welding process blossomed into a nationwide business, he since has flown 500 hours every year and promises to top that figure in 1951.

Called upon for an acceptance speech when Bill Mueller, (right of Mrs. Harman) Manager of Sauthwest Air Rangers, El Paso Navion dealer, presented him his bronze plaque, Harman told his audience that he hoped the occasion would make more businessmen aware of the job that can be done with the right tool for today's transportation: the modern executive plane.

"Editor" C. L. Foushee Jr. proudly displays his eight "first editions." As a field service representative for Ryan, Foushee is "author" of service manuals on exhaust manifold systems.

AN EXHAUST'S PRIVATE LIFE

WHEN C. L. Foushee, Jr., became a field service representative for Ryan Aeronautical Company's Metal Products Division specializing in exhaust systems, he didn't realize he'd be going into the publishing business.

Today, with eight "books" to his credit, Foushee can be considered an "author" as well as a technical authority. His books haven't become best-sellers, but to their group of readers, they're all-important. The "books" are service manuals which provide information needed by users of Ryan exhaust equipment for their proper maintenance. Each "book" can be said to bare the private life of an exhaust system.

Foushee's first creative effort in the publishing field was the service manual on the Douglas DC-6 exhaust system. Since then, the demand has been steady. He has turned out manuals on the manifolds for the Convair 240 and T-29; Boeing 377 Stratocruiser, C-97 Stratofreighter and B-50 bomber; Fairchild C-119 Packet and Douglas C-124 Globemaster.

Now he's gathering material for two more manuals, on the Piasecki HRP-2 and HUP-1 helicopters.

Like an editor who coordinates the flow of information from numerous news sources, Foushee gathers his data from various channels and organizes it into a neat package of information.

His "news sources" are not only Ryan's own engineers, welding technicians and metallurgical laboratory personnel, but the prime contractors' service and engineering groups, the commercial airlines and the military.

A manual is published only after a prototype of the exhaust system is built and enough have gone into service to provide the answers of what to expect under actual operating conditions. Once published, the manual doesn't remain a fixed, arbitrary compendium of facts. Like a history book or encyclopedia which must be changed in new editions to reflect new conditions, the manual is constantly revised to keep up with changes made by engineers as a result of service experience.

Foushee, right, checks with Wilson Hubbell, Ryan chief metallurgist, on data for one of his "books."

Let's take a look at a typical service manual. Like any book, it has an introduction and several chapters. The introduction is a general description of the main items in the exhaust system. The chapters deal with the principal features of installation, maintenance, repair and inspection.

Chapter I is likely to be a reference parts list, giving the installation numbers and the sub-assemblies required for complete installation, including all bolts, nuts, washers and cotters. This data is obtained by Foushee from a parts catalogue prepared by the engineering department.

In Chapter 2, an installation instruction sheet is included. This is first checked with the Ryan engi-

(Continued on Page 18)

AIRCRAFT workers are the homing pigeons of industry.

Between wars or national emergencies, many of them scatter to far-flung places and varied occupations.

But, whenever the full-throated roar of America's aerial might is needed, they flock back to their old job stations.

They drop their peacetime activities and return to the rivet gun, the drop-hammer, the punch press, the drill, the lathe and the countless tools that forge America's unbeatable industrial might.

"It gets under your skin, and always stays a part of you, I guess," a grizzled Ryan machinist remarked.

"For me, it was like coming back home."

At Ryan and other aircraft plants, personnel managers harassed by the shortage of skilled manpower are thankful for

Like homing pigeons, Fred Magula, left and John J. Harrigan are back on aircraft jobs after periods of absence between national emergencies.

"YOU'RE BACK, TOO!"

these "homing pigeons." They comprise a quickly tapped pool of savvy labor which immediately swings into the tempo of defense production.

Lloyd Doerge

"It's though they had never left," says James W. Bunnell, Ryan personnel chief. "Many pick up their tools and go to work as if they were just returning from a weekend."

Employment managers say they see "halos" over the heads of the "oldtimers" when they appear for rehiring. "We're tickled pink to have them back," an executive remarked.

Ken Matthews

When World War II ended and aircraft orders were cut back, many workers returned to their former homes all over the country and took jobs there. The yearning for San Diego was never quelled in many hearts, and in recent months the influx to their "adopted" home has resumed.

"We're beginning to get letters of inquiry from World War II workers, asking if there are jobs for them should they come back to San Diego," Bunnell declared. "Since the last war, they've been working on farms or in small businesses in all parts of the United States, and now they're anxious to return to the aircraft industry."

For example, Kenneth Matthews, a manifold assembler who was terminated at war's end, went back to Lake City, Iowa, where he worked in a welding shop and drilled wells until he heard that aircraft jobs again were available in San Diego.

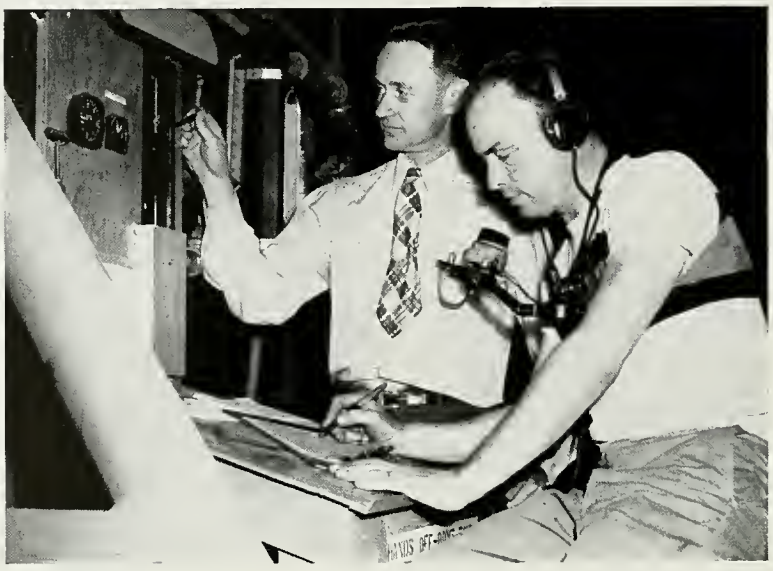
"I always wanted to come back," he explained. "I never found a better place to work."

Lloyd Doerge, a welder, spent the years since World War II in and around La Crosse, Wisconsin, on various welding jobs. He returned to San Diego recently. His simple explanation: "I enjoyed working here before, so I came back."

Many experienced the tribulations of being "one's own boss" after World War

(Continued on Page 22)

They're back, too. W. A. Meixner, left, and Cecil R. Hamlet, returned to familiar scenes when they resumed their employment in the Ryan plant.



SAND THAT SAVES TIME

The sand which filters down the hourglass of production is buying more time at Ryan Aeronautical Company today.

For years, a white silica sand was utilized in the high pressure blasting that cleanses metal parts. These sand particles deteriorated rapidly, and a fine dust, of no further use, was created.

It was discovered that a reddish garnet sand quarried from a mountainside at Fernwood, Idaho, had 50 percent better "staying" powers than the silica sand. Ryan was one of the first aircraft plants in the west to experiment, successfully, with this material on a large scale.

The garnet mineral base provides a much more abrasive material than the silica, according to Ray Ortiz, manifold and fabrication superintendent at Ryan.

Left: Sandblasters used to work in a "cloud of dust" when silica sand, easily disintegrated, was utilized. Right: Atmosphere has cleared up in sandblasting operations with use of more durable garnet sand.

"It takes only half as long to sandblast a part, and with less air pressure," he says. "The particles don't pulverize as easily."

An examination of garnet sand crystals after some use shows that when they do break down they retain their sharp features and the cutting qualities so necessary in sandblasting. In contrast, the silica sand disintegrates into "round" crystals of no further value in cutting action.

Thus, although garnet sand is more expensive than silica sand, it lasts much longer and does the job faster. A considerable saving is effected.

There's quite a color contrast in two types of sands. Silica sand, left, is white, while garnet sand, shown at right, is of reddish hue.

On two eight-hour shifts, the sandblasting machines had to be loaded at least six times with silica sand. Now, the machines need be filled only twice, once for each shift.

Less residue also means less of a problem in trucking away waste material.

And in rainy weather, garnet sand, won't clog up as easily in the moist atmosphere.

By use of a new industrial abrasive, Ryan is proving that sand can buy valuable production time.

Note "chalky," soft appearance of silica sand crystals, at left, as compared in microphotographs with harder garnet crystals, at right.

AN EXHAUST'S PRIVATE LIFE

(Continued from Page 15)

neering department and with the operator in the field. Foushee points out that under operating conditions, techniques of installation may be developed that may prove superior to the concept in the factory. The installation instructions are comprehensive, ranging from removing the protective covers after the engines are taken from their shipping crates, to the proper fit of bolts and nuts and how to check the exhaust system during the initial engine run.

Chapter 3 deals with the inspection procedure — what sections should be observed periodically while the exhaust system is in operation in the aircraft.

Ryan's vast store of exhaust systems experience is drawn upon for recommendations in Chapter 4, dealing with maintenance and repair. Included is information on the minimum limits to which parts can be checked — such as flange and material thickness with regard to wear. You'll find minute instructions, as, for example, "Check clamps for cracks around bolt lugs." Definite limits of thickness are set, and the part is to be discarded if wear has caused it to become thinner than a certain dimension.

Chapter 5 is the story of proper alignment — the use by operators of their own fixtures for checking parts at overhaul periods. Ryan supplies the operators with drawings of fixtures to assist them in producing alignment jigs.

The sizing of parts is told in Chapter 6. When a part leaves the Ryan plant, it has a definite close tolerance dimension. If it is re-sized to that dimension in the overhaul period, the amount of leakage and wear and general installation problems are held to a minimum. Ideal dimensions are contained in this chapter.

Recommended and accepted welding practices for repairs by the operator are outlined in detail in Chapter 7.

If a new material is used, a separate chapter will acquaint the operator with its characteristics. For instance, on the Boeing 377, a new high heat resistant steel alloy, 19-9DL, was used for the first time in a Ryan exhaust system. In the service manual for this system, considerable attention is given to tensile strength, percentage of elongation, scaling temperature, stress rupture properties, etc.

Information also is given on the different techniques required in welding and the type of rod to be used on the new alloy.

Foushee's service manuals aren't all words. There are also usually either a series of photographs showing the entire assembly and parts list, or a detailed blueprint.

Biggest circulation attained by Foushee's "books" was that for the DC-6 exhaust system, on which 250 copies were distributed. On a commercial plane order, the prime contractor requisitions a certain number of copies, or supplies Ryan with a list of users of the aircraft and the number to be sent each.

On military planes, a specified number is sent to the prime contractor, who distributes them to the personnel in his own factory requiring this information, and to field service representatives. The military itself digests the manual and places the essential information into the bulky AN Handbook, which covers every item in the complex mechanism of a modern plane.

Copies of the manual are also supplied by Ryan's own service and sales representatives for reference in meeting problems that may arise in the field. Other manual users are the Air Materiel Command at Wright Field and the Civil Aeronautics Authority.

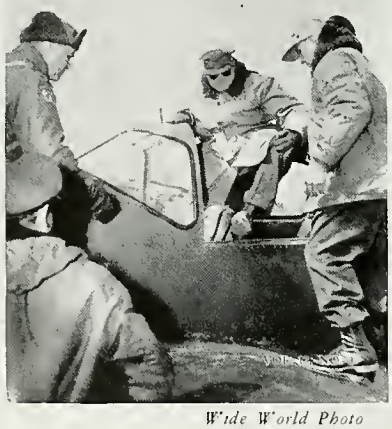
Manuals are usually revised and brought up to date about every six months. "We may have to replace 1 page or 20 pages," Foushee points out.

Like all authors or editors, he occasionally has last-minute headaches just before publication is scheduled—or even after it is printed.

Sometimes the manual is completed and ready for distribution when engineering changes suddenly arise. Foushee then must disassemble the manual and make the necessary revisions before any copies go out.

It's a job where speed and accuracy are factors as essential as in any well-run publishing business.

Ryan REPORTER



Wide World Photo

ON THE COVER

Lt. Gen. Matthew B. Ridgway, left, new Supreme Commander in the Far East, and General of the Army Douglas MacArthur leave a Navion L-17 Army Field Forces liaison plane after a flight over the Eighth Army's front lines on personal inspections of the Korean battlefront.

Capt. Eugene M. "Mike" Lynch, right, was pilot of the Navion and has flown General Ridgway on previous front line observation missions, generally using small airstrips at forward command posts.

A first-person account of how liaison planes are doing a job in the fighting against the Communists appears on Pages 2 and 3 with more action pictures of actual operations in Korea.

DASH SEVENTEEN

(Continued from Inside Front Cover)

altitude operation. It also is used on such experimental planes as Republic's XF-91 and the Martin XB-51 three-jet medium bomber.

With use of the automatic electronic controls incorporated in the "dash seventeen," responsibility of the pilot for operation of the powerplant consists essentially of pressing the starter button and regulating his throttle for the power he wants. Electronic "brain boxes" do the remainder of the work for him, and better than any human, by automatically regulating fuel flow and the tailpipe variable area nozzle to bring about optimum performance under any conditions.

The electronic system is simpler and much lighter than hydraulic controls and makes control of the powerplant easier for the pilot than has been possible for any jet aircraft engine ever developed.

The possibility of human error is reduced to the minimum, for the electronic aids keep a close check on engine operation. The system permits automatic starting; continually guards against conditions that could damage the engine; assures maximum engine performance at all times; and integrates control of both the basic engine and the afterburner, each of which has a marked effect on the performance of the other.

The "dash seventeen" is one of two new all-weather GE jet engines. The other is the J-47-GE-23 and is essentially the -17 without afterburning. The -23 is the same size as current production models of the J-47. Both new engines have more power than the J-47 which is rated in excess of 5200 pounds of thrust.

Strategic material content of the new -17 engine has been greatly reduced due to use of substitutes which are more readily available in time of national emergency. The substitutes have been made without any anticipated sacrifice in engine life or performance.

GOODYEAR ZepPeliN

(Continued from Page 11)

shroud which picks up the hot air surrounding the collector ring and channels it to the carburetor to insure its smooth performance.

The design of the ZPN airship calls for a speed of approximately 75 knots, but more important in the type of operation for which the blimp is intended, will be its ability to hover practically motionless over a given spot or maintain the relatively low speed of surface and undersurface craft.

The control car will have two decks with all operational stations on the lower deck, and crews' quarters on the upper deck. Six bunks and compact crew lockers will be in one upper deck compartment; in another will be an electric galley for providing hot meals; forward will be small compartment with two additional bunks for the ship's pilots and aft will be compact tables and seats where crew members may eat meals and relax during off-watch periods.

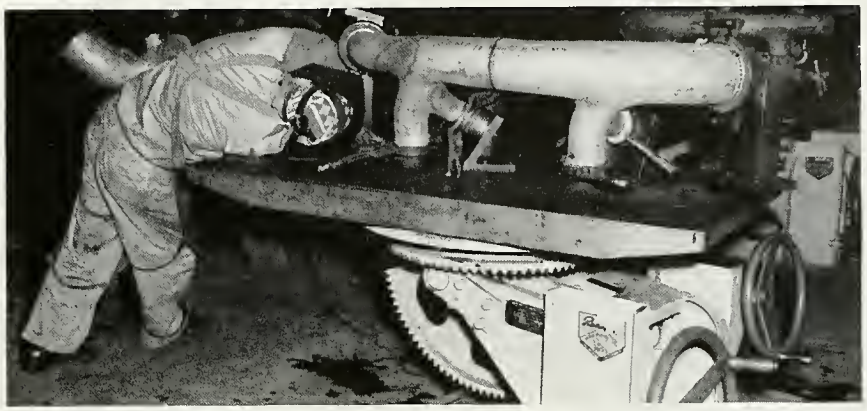
TRICYCLE landing gear, comprising a nose wheel and two larger wheels, one under each propeller outrigger, will be retractable. The nose wheel will retract into the bottom of the forward end of the control car and the main wheels and landing gear will retract into the streamlined nacelles of the outriggers.

Flight controls are subject to manual or automatic pilot operation. The pilot may control both vertical and horizontal direction alone, or, in cooperation with a co-pilot may divide the duties of maintaining altitude and direction. All controls can be operated through a single control column, which is duplicated at the stations of the pilot and co-pilot.

There will be four control surfaces on the stern of the ship, mounted at 45-degree angles from the vertical and horizontal instead of the more common 90-degree angle. The new control surface arrangement will contribute to the ship's maneuverability and stability. As all the surfaces will be operated in unison for either vertical or horizontal control, they will be known as "ruddevators" instead of "rudder" and "elevators."

Special equipment aboard the N-ship will make it possible to refuel in flight by taking on fuel from surface ships at sea, or to reballast by taking on water from the ocean through a water-pick-up system.

Control car will be constructed of aluminum alloy sheet forming a sandwich with balsa wood core. The envelope will be of Neoprene coated Fortisan rayon.



BEFORE: Welder George Lane demonstrates uncomfortable working angle when arc welding on table in fixed position—fun for contortionists but not arc welders.

"POSITION IS EVERYTHING . . ."

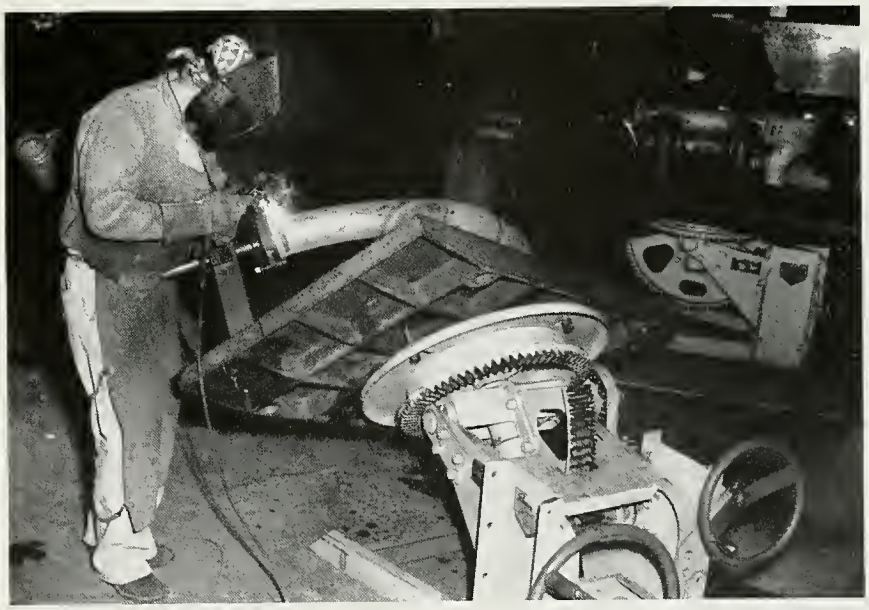
The observation that "position is everything in life" applies particularly to job efficiency in industry. Workers who must twist into uncomfortable positions aren't likely to turn out quality work at good production rates.

This has been recognized at Ryan, where increasing quantities of positioning equipment have been installed to improve arc welding.

In the first phases of this program, as applied to manufacture of Ryan exhaust systems, work positioning tables have (1) provided closer tolerances in the finished product; (2) enabled a continuity of operations on one table, thus saving time, energy and factory space; and (3) improved the quality of the weld because the operator is constantly working in an advantageous position.

A welder working in a "down-hand" position can use a much heavier rod, control the flow of metal to a greater degree, and can complete with one "pass" what would require two or three in positions at awkward angles.

Utilization of Standard Ransome Welding Positioners has "streamlined" the method of assembling and welding. The complete job of welding can be performed by tilting the table to various angles for the most advantageous positions, thus providing true jig locations and assemblies which are not warped out of shape from welding.



AFTER: Comfortable, efficient "down-hand" position in arc welding is achieved by utilizing work positioning tables which tilt to most advantageous angles.

BIRD DOGGING IN KOREA

(Continued from Page 3)

consider trying to round up some 200 prisoners from the air. The aviator who did was riding an L-5 on patrol when he spied a company of North Koreans. He radioed for the infantry, led it to the spot. The Koreans were captured, disarmed. Then the L-5 herded the whole pack down the road. It skittered back and forth at an altitude of 50 feet, buzzing the stragglers, and finally delivered the lot to a rear-area stockade.

Pickaback Capture

Another "businessman," Lieutenant Donald Bazzurro, of Staten Island, N. Y., didn't have a plane when his prisoner came along, but he got him anyway. Flying as an observer seeking artillery targets in the Taejon area, Bazzurro found his L-4 suddenly under attack by North Korean fighter planes. The L-4 went into a spin and crashed on an open hillside slope.

The pilot was seriously injured and Bazzurro's left ankle was broken. They were only a few miles from the U. S. lines, however, so Bazzurro hobbled off to find help. The first person he met was a North Korean rifleman.

Snapping out his .45 automatic, Bazzurro captured the man. And what then? Why, he just climbed onto his prisoner and rode him, pickaback, to safety. A patrol later rescued the pilot.

A mission for the artillery, such as Bazzurro's, is the kind the aviators fly most frequently. *Eighty-five per cent of the artillery fire in Korea has been directed by light planes cruising over the target area.*

As artillery spotters, the little fellows, weak and weaponless themselves, command terrific firepower. During World War II, I remember, an aviator once called up an entire corps of artillery—more than 400 guns—to punish a single target in Italy.

Generally, in Korea, the spotters fly at 2,000 feet, just out of the range of enemy small-arms fire. They stay within sight of the objective, but off on a flank to avoid getting blasted by one of their own shells.

The grimmest and most effective bit of spotting done in Korea while I was there involved a column of North Koreans approaching a cross-road. An aviator directed 16 guns in on the point, had one salvo dumped on the leading elements of the column, switched a battery to the enemy rear, and then played the other guns up and down the road on the troops between.

You name it, the light planes will do it. *They dropped food, water, ammunition and medical supplies for five days until a battalion, isolated in the hills, could fight its way out of a North Korean trap.* They evacuate the dangerously wounded from front-line aid stations, although this is a job at which the gawky helicopter excels. And one fellow, directing a fighter-plane strike, let down in enemy territory to rescue an F-51 pilot who had been forced to bail out.

Last Word in Couriers

They are also used for front-line photography, and to lay telephone cable, a mile a minute, while flying at treetop level. They are dispatched on courier duty; one communications officer estimates that a single plane is worth 20 jeep messengers.

When infantry outstrips its communications, light planes keep the units in contact with each other. When armored columns are on the move, light planes scout the route ahead for blown bridges and enemy road blocks.

Robert C. Miller, famed United Press war correspondent, who recently returned to San Diego on leave from Korea, paid high tribute to the Ryan Navion L-17B's in action on that front.

"They are extensively used as artillery spotters and for all kinds of utility jobs." Miller said. He recalled that one of his most comfortable trips in his arduous months of Korean war coverage was a flight in an L-17B from Masan to Pusan.

"The L-17B's have won a fine reputation for themselves in Korea," Miller remarked.

Such popularity keeps the aviators fairly busy. I know one who piled up 180 hours of flying time in a month. Is this a lot? Well, the average commercial airlines pilot in the States logs about 75 flying hours.

Another has an Air Medal with 29 clusters. One cluster for every 10 missions.

Granted, the missions are short, two or three hours at the outside. But there are no automatic controls in an aerial vehicle; you're flying it every minute. At the end of six hours, you've earned a vacation—but try and get it. A number of the boys have flown nine hours a day for two weeks at a stretch. For all this, their casualties in Korea have fortunately not been high. Only occasional enemy air action and anti-aircraft fire, which are usually the main hazards, have been encountered. Another place, another time, the story might be different. Actually, just operating day to day is tough enough.

If you know of worse flying conditions than those in Korea, I don't want to hear about them. Korea is a land of mountains and rice paddies. That's all. The aviators can't fly off hillsides, so they do what they can with the paddyland.

Prepare for Pancake Landings

The surface generally is six inches of mud. You should have 1,000 feet of runway for an L-5, 1,500 for an L-17. Some fellows have gotten off in 600, although it's not clear exactly how they did it.

Aloft, the cold air freezes the mud caking your landing gear. You fly your mission, return home and prepare to let down. Is the landing gear locked in place? The frozen switches will never tell you. Unless you get an indication from the ground, you come in ready to make a pancake landing.

Of course, you can always take off or land on one of Korea's few roads—if you can get a mechanic to halt truck traffic long enough. *One fellow I know took off with a string of railroad boxcars on one side of him, a wall of supplies on the other, and trucks crossing his path fore and aft.*

At that, I think he was better off than the lad who came down for a forced landing in an ammunition dump. He picked his way neatly through the TNT until he hit a pothole and nosed over, coming gently to rest on a crate of 105-mm. artillery shells.

Aviators caught out after dark also have their problems. The usual excuse is that they were "having a good shoot," but that doesn't make landing on a blacked-out airstrip any easier. I know of several who came down safely by the light of two little C-ration cans filled with burning gasoline.

No-Man's-Land Salvage Job

If things have been dull upstairs, however, there's always something to do on the ground. In the Pusan beachhead days, when spare parts were short, Captain William Gardner, flying ordnance officer, went out to salvage an L-5 abandoned in no man's land, four miles ahead of the U. S. lines.

He did. Got the engine, the propellor and some of the instruments onto a truck while three mechanics exchanged rifle fire with North Korean snipers.

And then, too, once you hit the sack at night, there's no assurance you'll get any rest. Airstrips are usually isolated from the main body of troops and, until the aviators caught on, made nice targets for enemy hit-and-run raids. Usually at 3 or 4 a.m.

One strip now has impressed the Division Band into service as its perimeter

defense, and all of them have quadruple-mounted, 50-caliber machine guns — "meat choppers" — posted around to repel attackers. Presumably, everyone sleeps better, if not longer. Aviators must be ready to take off at 6:30 in the morning.

Most military airplanes are designed to do one job superlatively well. Fighters fight and bombers bomb, and the men who fly them are specialists.

In the Army aviation business, it's different. Variety is a virtue, diversity an advantage. The unconventional is acceptable, as long as it gets results.

One aviator in an unarmed L-17 even destroyed a T-34 tank. Scared it to death. He buzzed the tank to get a good look. The tanker mistook him for his big cousin, the F-51, rolled off the road and turned over.

I tell you, those guys can do anything!

Company Directors and Officers Re-Elected

Annual Meeting of the Stockholders of the Ryan Aeronautical Company was held at the company's offices in San Diego on March 20th at which time the five directors were re-elected to serve during the coming year.

Following the adjournment of the meeting, the directors met and at that time the present officers of the company were re-named for the ensuing year. These are T. Claude Ryan, president; G. C. Woodard, executive vice president and treasurer; Earl D. Prudden, vice president; C. A. Stillwagen, secretary; L. L. Underwood, controller, and D. H. Ockerman, assistant secretary and assistant treasurer.

Of the company's 439,193 outstanding shares, 314,716 were represented at the meeting by person or proxy. Stock of the company is held by 1200 stockholders.

In addition to Ryan, Woodard and Prudden, other members of the Ryan Board of Directors who were re-elected are C. Arnholt Smith, Chairman of the Board of the United States National Bank, of San Diego, and Melvin H. Lockett, partner in Mattison, Thomas & Lockett, certified public accountants of Los Angeles.

New Assignments

A veteran of 17 years' service at Ryan, Will Vandermeer, has been named Chief of Mechanical Design. Succeeding him as Chief of Development Laboratories is W. S. Cockrell, who has been closely associated with the XQ-2 project at Holloman Air Force Base, Alamagordo, N. M. Wilson G. Hubbell, who as Chief Metallurgist acquired a reputation as one of the outstanding authorities in this field, is the new Assistant Chief of Development Laboratories.

SEA GOING L-17

(Continued from Page 4)

fore it passed the island, though Capt. Capps had told us he planned to use the whole deck before taking the Navion off.

WE were prepared to receive the L-17 for a landing if Capt. Capps found the situation such that he could not safely set it down ashore. We learned, however, that he brought the plane down on a highway and soon afterward Gen. Almond began using it to inspect the combat areas.

I understand that at the Navy's Ream Field near San Diego, simulated carrier landings were made in the Navion by Ryan's William P. Sloan to demonstrate that it would be practical to land on a carrier without use of an arresting hook.

Actually, the Navion had earlier proved itself capable of flying from a carrier during "Operation Portrex" in the Caribbean during the spring of 1950, when one took off from the USS Leyte. However, the takeoff from the USS Badoeng Strait was the first under actual combat conditions.

The L-17's have performed magnificent service for the Navy in providing information that has enabled our Marine planes to give ground troops close support in Korea.

Navions searching for the enemy, radio position data to a jeep on the ground, which relays the message to a control center, summoning the attack planes. Once our fighters reach the target area, the Navions communicate directly with them, and if the weather is overcast, sometimes actually lead the high-powered fighters right to the enemy troops and installations.

The unarmed Navions were prime targets for anti-aircraft weapons, as our fighter pilots well know from the unusual dialogue that occasionally took place during an attack operation. The Navion pilots would casually, and with good humor, remark that they were dodging shells—at the same time giving directions on the best angles for our Corsair F4U fighter planes to approach the targets.

We developed a great respect and admiration for the Army Field Forces pilots who risked their necks in flying low over the enemy to provide the information vitally needed to blast obstacles away from the path of our troops.

And, on the USS Badoeng Strait, we take pride in having provided an amphibious feature to such operations, by effecting the first combat operational takeoff at sea of a Ryan Navion L-17B.

MISSILE CLASS

(Continued from Page 5)

visits and inspection of production departments. There were limited demonstration and motion pictures of several secret projects and others of a classified nature on which Ryan is currently working. Work in the fields of electronics, guidance systems, jet propulsion and exhaust systems research were studied. Ryan's XQ-2 jet propelled pilotless target plane was included in the laboratory and production inspections, and motion pictures included those showing the Ryan "Firebird" air-to-air guided missile.

Lt. Col. Jose E. Olivares, an artillery officer, was the senior officer of the visiting group.

ZIPPWALD PROMOTED IN CUSTOMER SERVICE

A personable young man who describes himself as "just a farm boy," has been promoted to the post of assistant director of customer service at Ryan. Fifteen years ago he was an hourly paid aircraft worker.

He is Jack C. Zippwald, 35, who was spotted in 1938 by Sam C. Breder, director of customer service, as promising executive material when he had risen to the post of assistant foreman in the exhaust manifold assembly department.

That was the year in which Ryan was making long strides toward its present position of leadership in the production of stainless steel exhaust systems for aircraft. As the volume of manifolds in service increased meteorically, it became necessary to have a field service representative. Breder chose Zippwald as the first such representative to help customers with their engineering and service problems on manifolds.

Zippwald travelled throughout the United States and into Canada. "For a farm boy with just high school training, it was a wonderful education," he says.

After World War II, Zippwald was named field representative for the Southern California area, where he provided liaison with some of Ryan's largest customers.

Zippwald achieved his "farm boy" appellation honestly. Although a native of Chicago, he came to California with his family at the age of 4 and settled on a citrus ranch in Lemon Grove, a San Diego suburb.

Today, Zippwald has a 24-acre ranch of his own in Lemon Grove. To help pay for the land, he often spent weekends operating his own tractor for other farmers on a for-hire basis.

Breder pointed out that the advance of Zippwald is typical of Ryan's policy of grooming executives from the ranks of its own employees.

"YOU'RE BACK, TOO"

(Continued from Page 16)

II. They went into business for themselves, now are satisfied with holding down jobs helpful to the defense effort.

Still others took prolonged vacations after the long period of intensive work under pressure.

Cecil R. Hamlet and his wife travelled for almost 4 years. He had started in the aircraft industry here in 1936, climbing to foreman of sheet metal fabrication ten years later.

"My wife and I wanted to see how other people lived," Hamlet explained. "We learned a lot, and discovered that San Diego is the best place to live and work."

Today Hamlet is handling pressure tests on the Boeing Fuselage sections being built by Ryan. He had to start out as an hourly paid worker, but "I'm sure battling to become a foreman again."

Those who left the industry of their own volition for "greener" fields often regret they lost their continuity of employment. "I wished I never had left," said W. A. "Bud" Meixner, an assistant foreman. "I might be better off today."

The new emergency has also brought many old-timers out of the "mothballs" of retirement.

OBSERVE, for instance, John J. "Red" Harrigan, one of San Diego's most colorful pioneer aviators.

"Red" entered naval aviation in 1916, flew for 9 years before returning to civilian life as a flight instructor and test pilot for Ryan. The depression of the early thirties separated him from his job, also. "Gold fever" sent him on a none-too-profitable flying expedition to the Yukon territory. Later he served as private pilot for a millionaire in Chicago. For three years he was Lindbergh Field Manager for the San Diego Harbor Department, until the Navy called him back to active duty in the last war.

After the war, he relaxed in his home in Harbison Canyon for several years.

"But I got tired of lying around doing nothing, and there was just one place for me to do any good when this new emergency came up," he said. "That was in the aircraft industry."

Today, at 63, "Red" Harrigan happily drives 60 miles each day to and from work as an inspector at Ryan.

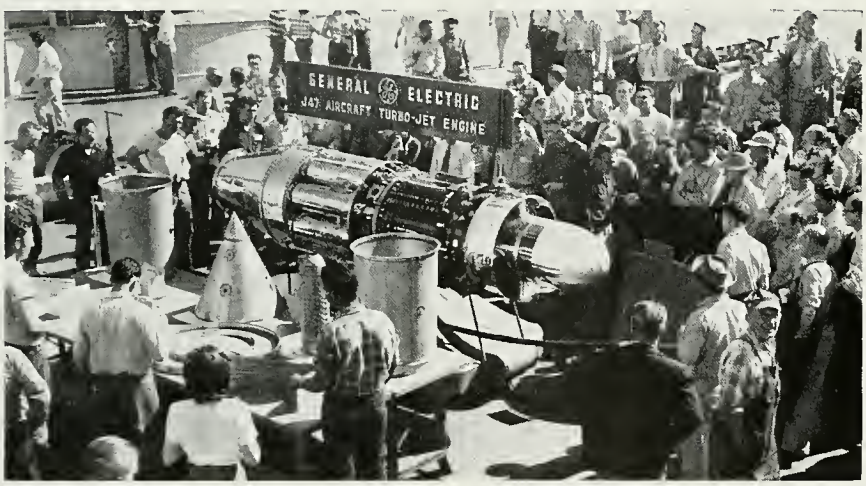
Or, take the case of Fred Magula, who has spent most of his adult lifetime in the aircraft industry, except for the between-wars vagaries of employment. Fred was one of the small gang of enthusiastic Ryan workers who labored day and night to finish Lindbergh's "Spirit of St. Louis." Later he went to St. Louis to work for Lindbergh's backers. Eventually he wound up in Detroit, out of a job when the depression hit in 1932. He returned to California, entered the baking business with his brother in Fresno.

But the "homing pigeon" instinct asserted itself in 1935, and when business picked up at Ryan, he returned. For ten uninterrupted years, Fred remained in the aircraft industry, until the postwar production cutbacks which displaced thousands of workers.

During the years of uneasy peace, he operated a service station in Chula Vista. When the Korean War ended the aircraft industry's starvation diet, he made a beeline for his old haunts. Today Fred Magula is happily working away as a mechanic on the giant fuselage sections produced by Ryan for the C-97 Boeing transport.

Throughout San Diego's aircraft industry, reunions are taking place daily.

"You're back too!" is the cry being heard as Ryan "homing pigeons" come home to roost.



Ryan Workers Study G. E. Jet Engine

Ryan employees recently viewed the powerful General Electric J-47 turbo-jet engine for which they are building numerous component parts, including combustion chambers, exhaust cones and transition liners.

A "cut-away" of the J-47 to expose its inner workings was displayed in the outdoor cafeteria plaza during rest and lunch periods. Employees were able to manipulate a lever which caused the mechanism to revolve slowly.

Accompanied by Daniel W. Stowell, foreman for General Electric's aircraft gas turbine division in Lynn, Massachusetts, the "cut-away" engine is on a nationwide tour of factories providing parts. "We want workers to see the end product to which they're contributing," Stowell explained.

The J-47 is the most powerful turbo-jet in full-scale production in the United States.

METAL MAGIC

(Continued from Page 9)

form chromium carbides which deposit along the grain boundaries and form a path for intergrannular corrosion. This carbide precipitation destroys the steel's most valuable property: its corrosion resistance.

Ryan employs other procedures in the event that welding speed alone is not sufficient to avoid reduction of corrosion resistance. The material can be heated, after welding, to 1900° F. where all of the ingredients are in solid solution and the materials fully annealed, then quickly cooled through the critical temperature range. This method restores corrosion resistance.

Another solution, which Ryan frequently takes advantage of, is the addition of columbium or titanium to the steel formula to act as a stabilizing agent. Then, when the carbon precipitates out in the critical temperature range, it combines with either of these elements and forms carbides which are not harmful because they are well distributed throughout the material and cannot form a path for intergrannular corrosion.

The metallic arc process enables the welder to lay a deposit, the analysis of which is subject to very accurate control. This is possible because the composition of the weld deposit is the result of interfusion of two known compositions—the material being joined and the metal in the electrode. This facility is capitalized

upon when unstabilized steel is welded. By using a flux which contains the stabilizing element of columbium in its formula, it is possible to thereby add columbium to the weld deposit and obtain a weld of excellent composition.

Metallic arc welding is excellent for the welding of a wide variety of corrosion-resistant steel exhaust systems for conventional aircraft engines. Ryan is building these high temperature structures for the Boeing B-50 bombers, and C-97 Stratofreighters; Douglas DC-6 airliners and C-124 cargo planes, Fairchild C-119B troop transport and a host of others. In these components, the process is used to weld flanges, doublers, hangars and fittings to the exhaust systems. Typical task is the precision welding of B-50 port flanges, which are ¼" thick, to the thin-walled exhaust tubes made of .043" sheet metal. These parts must be accurately fitted to mammoth Pratt & Whitney 3500 h.p. engines and the flanges and tubes must be precisely aligned to mate with the engine's close tolerances.

Corrosion-resistant steels expand 50 percent faster than ordinary steel under the application of heat and conduct heat only one-half as rapidly. Consequently, they are more subject to distortion from heat and the welding heat remains longer in the weld area. Metallic arc welding performs the difficult job of attaching the thick B-50 flanges to the thin exhaust tubes without distortion because of its incredible speed. Ryan welds thicknesses from 20 gauge to one-half inch with this process, although it is generally considered that a thickness of about 3/16" is the maximum which can be welded with one pass of the arc.

In the early days of our industrial development, light weight and compactness were seldom major design factors. In recent years, we have become severely conscious of these restrictions because of the limitations in supplies of metals and the increased tempo of high speed transportation. Aviation demands careful analysis of weight-strength ratios in all structures. Metallic arc is an outstanding factor in the solving of these problems. Its use has struck a double blow for aviation transport. Modern planes can carry more payload because of their stronger, lighter construction. And, new metal products (many of which are transported by air) are made of lighter materials because of new design possibilities.

PLANT TOUR

Unfortunately we don't have the opportunity to show many readers through the Ryan factory, but we can ask you to join us in this column while we go through the plant and meet some of the people who help make Ryan a better place to work.

PRESIDENT'S SON NOW AIR FORCE PRIVATE

David Ryan, eldest of president **T. Claude Ryan's** three husky sons, is now a private in Uncle Sam's Air Force. Dave, who has just turned 21 and had been working in the Engineering Department since last June, said "I will" at the Air Force recruiting office at the Marine Base and left early in March for Lackland Air Force Base, Texas.

David Ryan

At Lackland, he will go through the rugged basic training for Air Force recruits. After that Dave hopes to be called for flight training as an Aviation Cadet for which he passed the examinations last August.

Just two days before he left for military service, Dave qualified for his private pilot's license. Wanting to get a head start on flying, he had been training at Gibbs Flying Service under **Pete Larsen**, former Ryan School of Aeronautics flight commander.

Jerry Ryan, 19-year-old son of the company president, is a member of the Air Force Reserve Officers Training Corps at Stanford University where he is studying Mechanical Engineering. Jerry is scheduled for active duty when he finishes his college work.

Youngest of the three boys is **Stephen Ryan**, aged 12 but already 5 feet 7 inches tall. Steve, of course, thinks his two older brothers are pretty much okey.

A FRIEND IN NEED . . . . . .

Two young people who thought they were "alone" in a city across the country from their homes have discovered the warmth of new-found friendships in a unique manner.

When **Paul E. Laine**, service representative of Fairchild Aircraft and Engineering Corp.'s Ranger engine division at Farmingdale, Long Island, N. Y., was sent to Ryan Aeronautical Company, San Diego, Calif., plans for a May 5 wedding in Long Island became uncertain.

A service representative never knows where his next stop will be. The entire country is his "beat," especially when his company has far-flung projects.

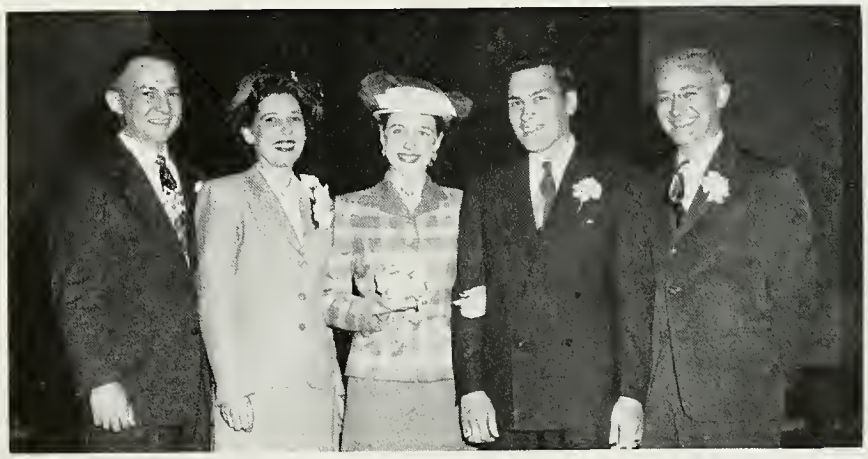
So his fiancee, **Joan Wilson**, came to San Diego and they decided to be married there immediately.

Members of the Ryan Engineering department with whom Laine had been working for only a week heard about the wedding plans. They pitched in and helped arrange the ceremony in fine style.

Robert Shaver, Ryan project engineer in charge of preliminary design, served as best man, and **Mrs. Shaver** was matron of honor. **Forrest Warren**, project engineer, gave the bride in marriage.

After the wedding in Grace Lutheran Church, San Diego, the Ryan engineering department staged a reception in the Flamingo Room of Balboa Park's famed House of Hospitality. All the guests were from the Ryan plant.

After a three-day honeymoon, Laine returned to his assignment at Ryan, where he is service representative on equipment used in the XQ-2, Ryan's high speed jet-propelled pilotless target plane, half the size of a fighter with comparable performance.



After their wedding in the Grace Lutheran Church, San Diego, Paul Laine and his lovely bride, Joan, pose with Mrs. Robert Shaver, matron of honor, Robert Shaver, best man (far right), and Forrest Warren (left) who gave the bride in marriage.

British Here to Study Ryan Jet Target Plane

Great Britain's interest in a Ryan aircraft project of advanced design was disclosed last month when four aircraft engineers holding key posts in the Ministry of Supply, London, and the Royal Aircraft Establishment, Farnborough, inspected the Ryan XQ-2. This is a pilotless jet plane under development at Ryan Aeronautical Company for the U. S. Air Force and Navy.

The XQ-2 target plane is designed for training in high speed interception and anti-aircraft gunnery. It is radio-controlled, approximately half the size of a jet fighter plane and has comparable performance. Maneuvers of jet fighters can be simulated by this pilotless "drone" plane.

Here from the Ministry of Supply to view and obtain information about the XQ-2 were J. W. Truran and C. A. Jarman. E. D. Whitehead and W. O. Broughton represented the Royal Aircraft Establishment, the British development center for experimental projects. They conferred with Bruce Smith, Director of Engineering, and Forrest Warren, Jr., project engineer, of Ryan.

The engineers were accompanied to San Diego by Squadron Leader J. L. Tempest of the British Joint Services Mission, Washington; and Col. Otto Haney, head of the guided missiles section of the Air Force Materiel Command at Wright Field.

Tempest holds the British Distinguished Flying Cross for heroism during World War II, when he flew more than 30 missions over enemy territory in long range Halifax bombers.

SIGNED, SEALED AND SHIPPED

(Continued from Page 13)

ders, "packing instructions" must also be complied with.

Once shipments have been received from the stockrooms, the Inspection Departments' authority over the items isn't relinquished until they have been packed, weighed and their cases stenciled.

Materials for the Outside Production Department comprise another distinct shipping category. Sheet aluminum, for example, frequently is shipped to outside contractors for special working. Certain manifolds, too, must be sent to Los Angeles for a new type ceramic coating.

Shipments like these are rarely on a scheduled basis, usually being made as specifically requested by Outside Production. On many shipments, tools as well as raw materials are included. At present, heavy lead-alloy dies are being shipped to the Goodyear Aircraft Company's Akron, Ohio, plant to enable that firm to set up production on parts for Ryan-designed external wing tanks. An entirely new extra-strength shipping "skid" large enough to accommodate four of the 350-pound dies was especially designed.

Development of such new containers and packing methods is a primary duty of E. R. Wiles, General Superintendent of Shipping, Receiving & Transportation, who personally heads what is best described as "boxing and crating analysis." Several weeks before shipment of a product is scheduled to begin, he and his staff put their heads together to figure out how to pack the item to assure its complete safety in transit at the lowest cost to the company and the customer.

Another unique shipping job is the huge aft fuselage section built for the Boeing C-97 Stratofreighter. Shipping personnel take over handling of the section from Production at the exit door of the Final Assembly Building. There placed on special "saddles" aboard a giant trailer, it is next moved to the factory's own railway siding where big cranes lift it into position on the 45-foot flat car which will carry it to Seattle. Carefully coordinated with the procedure are Ryan, Boeing and Air Force Inspection.

Jet engine cones and jet tail pipes allow for assembly-line type packing and loading. Like Stratofreighter floor beams, they are produced and delivered to Shipping in constant flow. This makes practical the permanent assignment of key personnel who build up remarkable productivity by intensively specializing in the single task.

No matter how efficient a shipping operation may appear, it is under continual survey for discovery of ways to improve containers and packing methods. One simple improvement can produce savings of thousands of man-hours, tons of materials and large sums of money on shipping charges. In just two such improvements uncovered in recent months, savings of up to $50 per day were achieved, with benefits accruing to both Ryan and the customer.

More than three years of experience have also produced many time-saving techniques for shipping Ryan Navion spares. Under Ray Antrim of the Spares Department, a crew of packers readies the various Navion parts and assemblies, utilizing special boxes and crates devised for the purpose. Spares orders are filled for Navions in forty countries of the world.

After final approval on shipments from Inspection, every method of transportation is used to move materials to the customer. Air Express, Air Freight, Air Parcel Post and the company's own Ryan Navions are pressed into service for high-speed sky shipments of most urgently needed items. Rail express, parcel post, rail and motor freight do the rest. Within the Shipping Department, fork lifts, motorized "chore boys," trucks and escalators make the wide variety of operations click, keeping manual handling to a bare minimum. Together, they supplement human skill and efficient methods to give Shipping the mobility needed for distributing more than 600,000 tons of materials a month.

Ryan REPORTER

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Robert F. Smith, Navion news editor
William P. Brotherton, technical editor
Harold Keen, associate editor
Don Doerr, chief photographer
William Wagner, editorial director

IVAN is watching you

IVAN is a dyed-in-the-wool Communist. There are only 6 million party members like him in all Russia, yet these Communist brass-hats enforce the iron dictatorship of the Kremlin over *200 million* Russians.

He's sold to the hilt on Red ideas. Which means he's out to get *you*. He believes it's either you or him . . . that the world is too small for both.

Ivan is working hard to beat you down. He has a big head start.

Right now he's got you in a bad spot.

Ivan is afraid of only one thing.

He fears your ability to out-produce him in guns, tanks, planes.

Frankly, he doesn't think you value your free system enough to do it . . . to make willingly the sacrifices he has squeezed out of the Russians.

But he's wrong!

Because you and all of us have set out to build more and better weapons—to do it faster all the time.

We must use every bit of know-how and inventive skill we have to improve our machines and methods—to turn out more and more for every hour we work. Only in this way can we become militarily strong.

But we've got to supply essential civilian needs as well. We can't allow needless shortages to take prices skyrocketing and lower the value of our dollar.

Sure, that means sacrifices for everybody. But doing this double job well is the only sure way to stop Ivan in his tracks—and to save the freedoms which are ours and which he has never known.

THE BETTER WE PRODUCE
THE STRONGER WE GROW

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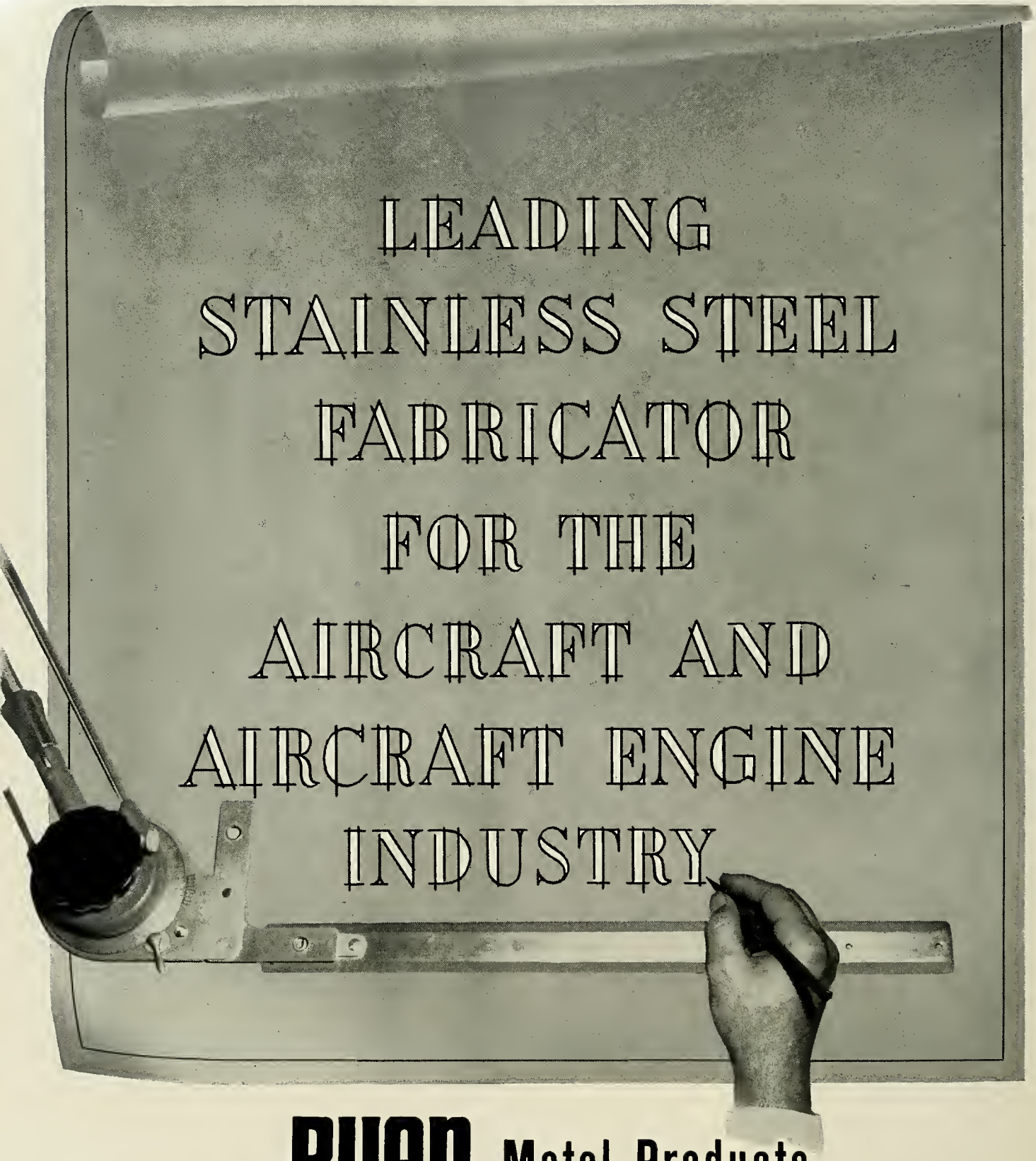


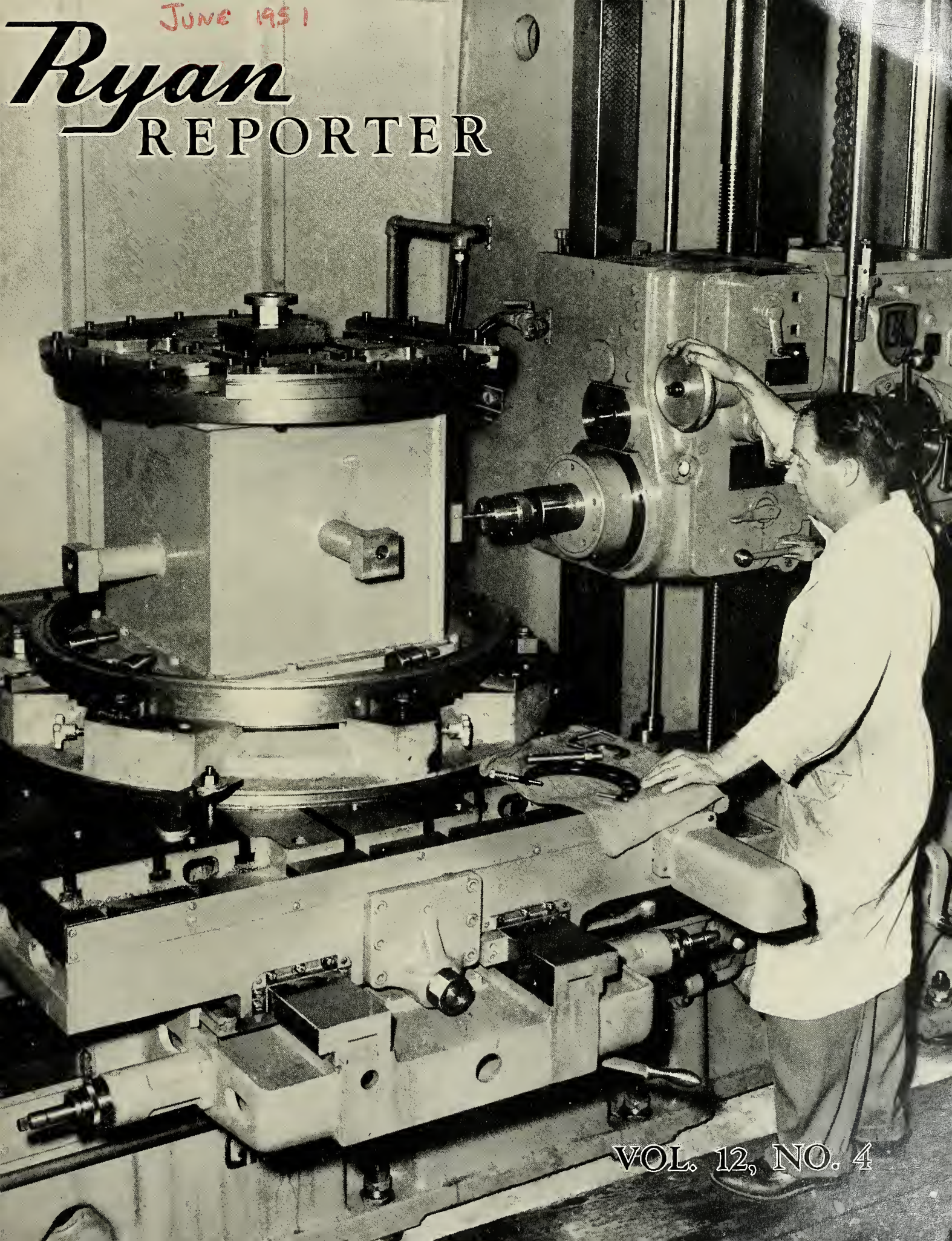
RYAN Metal Products

DIVISION OF RYAN AERONAUTICAL COMPANY • LINDBERGH FIELD • SAN DIEGO, CALIFORNIA

Exhaust Systems • Jet and Rocket Engine Components

JUNE 1951

Ryan REPORTER



VOL. 12, NO. 4

AMBULANCE. War casualties enjoy hospital room comfart during flights from overseas bases in spacious, pressurized cabin.

COMBAT EQUIPMENT. Huge, multi-wheeled army trucks fit easily in "aerial box car" equipped with cargo doors built by Ryan.

OPEN DOOR

Boeing's C-97 "workhorse" is Uncle Sam's most versatile air transport

WHEN cargo doors of the Ryan-built aft fuselage open on the mighty Boeing C-97 transport, the huge interior of the plane is likely to admit or disgorge anything from a 2½-ton truck to a complete aircraft ready for assembly, and anyone from 60 casualties returning from war to 134 fully equipped troops going to war.

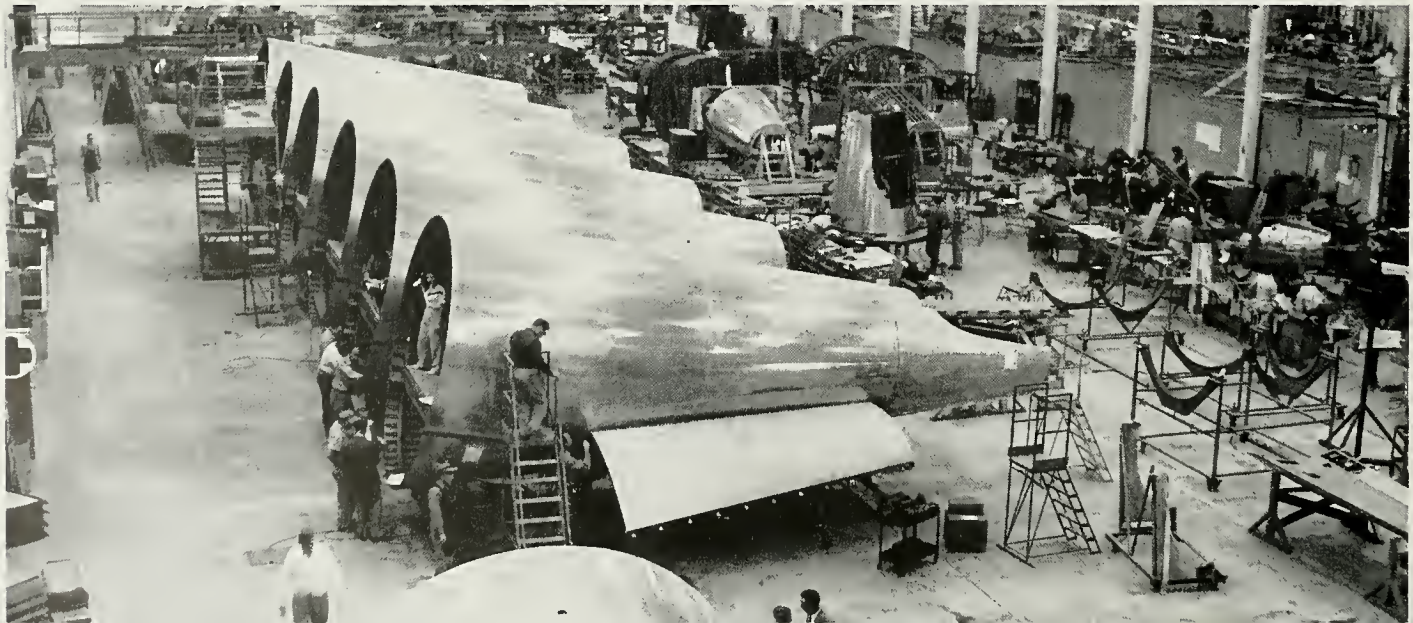
Through those cargo doors pass the most precious air freight in the world, as far as a fighting man is concerned. The C-97 has an "open door" policy aimed at speeding up movement of personnel, equipment and supplies — aimed, in the last analysis, at shortening wars.

Within a one-week period, this speedy workhorse of the skies can be a flying ambulance, a mail plane, an aerial box car, or a troop transport. It's just about the most versatile plane in the Air Force.

The Stratofreighter can take off with a gross weight up to 146,500 pounds of cargo. It can carry trucks up to 2½-tons, easily driven up

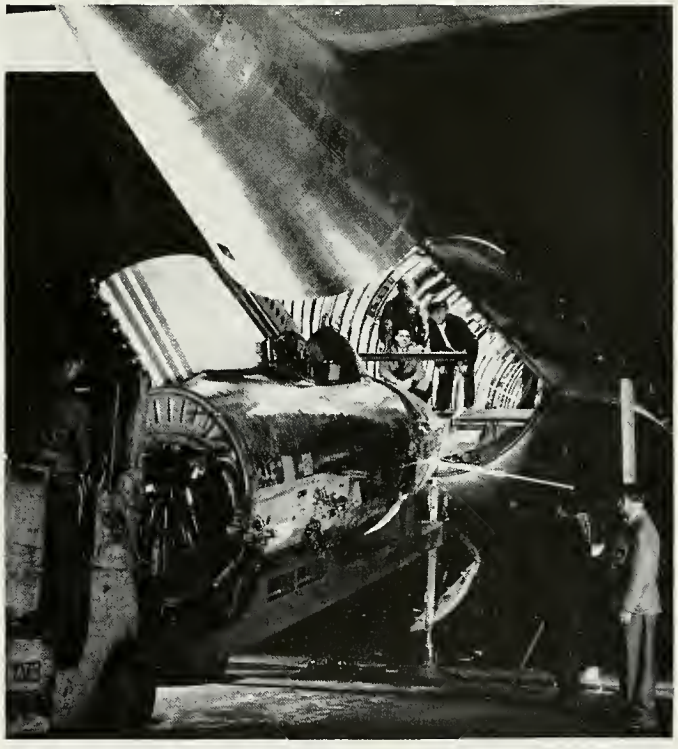
(Continued on page 20)

RYAN PRODUCTION. Production of C-97 aft fuselage sections and cargo doors is being accelerated by Ryan Aeronautical Co.



MAIL. The fighting man's eagerly anticipated commodity from home is carried in staggering quantities by "flying mail car."

CARGO. Anything from soup to bolts and nuts is crammed into cavernous cargo compartments of this workhorse of the skies.



PRIORITY FREIGHT. Disassembled experimental Republic fighter is loaded at New York factory for delivery to base at Muroc.

PARA-CARGO. Up to seventy tons of cargo can be parachuted from C-97 to areas where battle supplies are critically needed.

Army pilots were "leary" of flying what they thought was a "strictly airport" aircraft, but after proving her worth, the Ryan Navion L-17 is deservedly nicknamed "drafthorse".

U. S. Army Photograph

FRONT-LINE "AIRLINE"

WITH EIGHTH U. S. ARMY IN KOREA — The general concensus of Army airmen in Korea is that were it not for the L-17 Navion in the first six months of the war the effectiveness of supporting Air Force and artillery fire power would have been far less than was eminently necessary and happily possible.

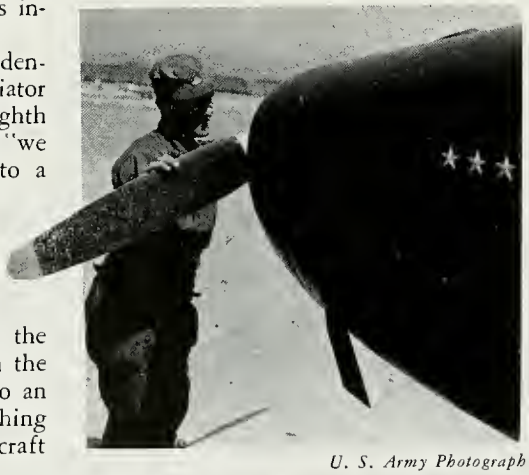
This coming from pilots who initially were "leary" of flying what they considered "headquarters" and "strictly airport" aircraft in the rough weather and rougher hazards of war-torn Korea is indeed praise.

Lt. Col. R. T. Neumann of Bradenton, Fla., who rates as top Army aviator in Korea because of his position as Eighth Army Aviation Officer, said recently "we took the Seventeen and made it into a utility plane.

"Originally designed strictly as a passenger craft, we've used for long-range reconnaissance missions which took it deep into enemy-held territory, we used it to direct the great proportion of fighter strikes in the early months, and we've made it into an airborne truck, transporting everything from general officers to light aircraft engines.

"To say that we have been pleasantly surprised at the way it's stood up under incredible conditions and that we've been favorably impressed with its accomplishments over here would be understating our high regard for the Navion."

The Colonel's praise for the Seventeen is echoed by everyone connected with Army air operations in the combat zone since last July from Ordnance officers and maintenance mechanics who have kept it flyable to the pilots who have sat behind the controls.



U. S. Army Photograph

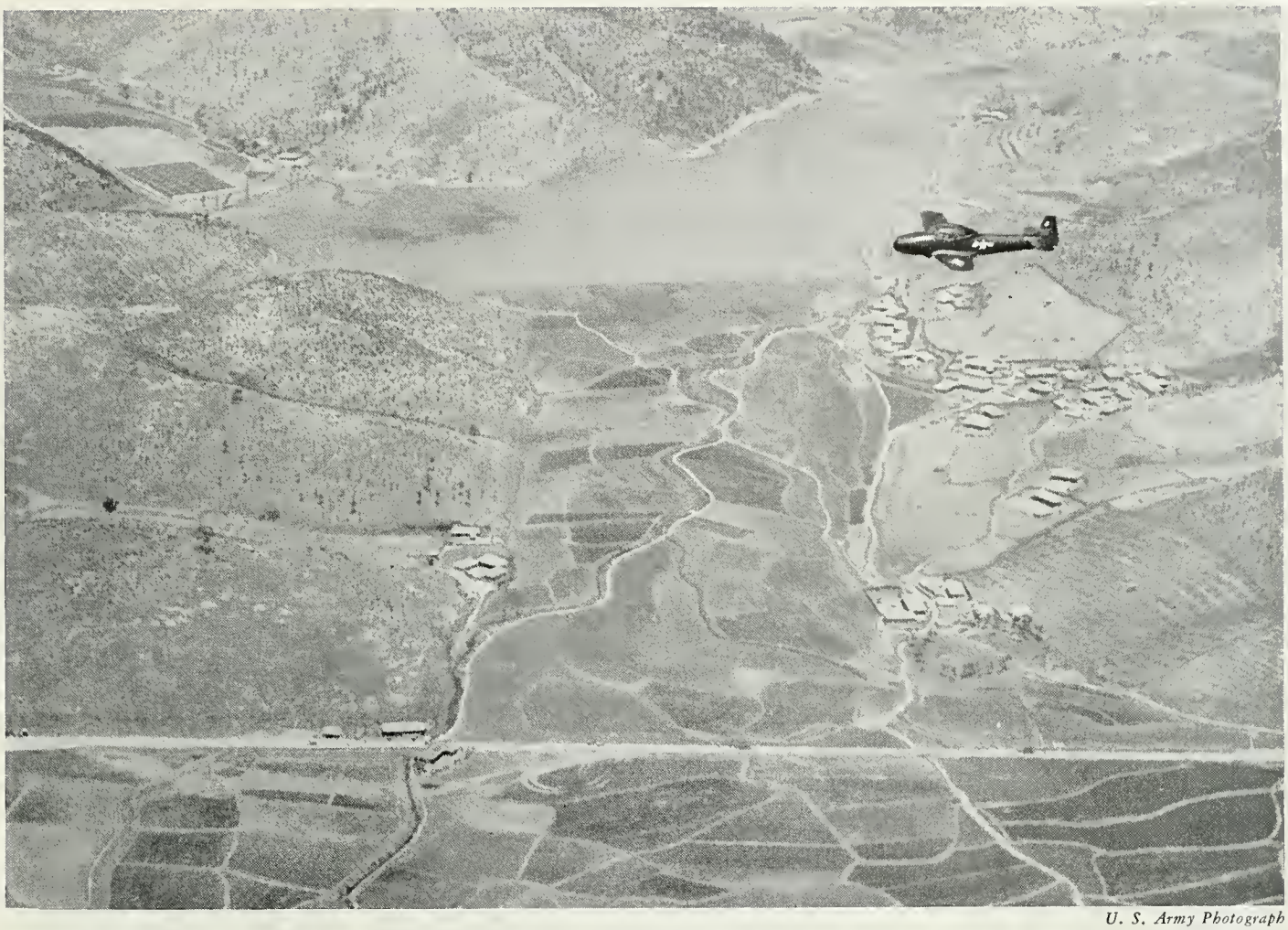
A light aviation crew chief checks the prop action on an L-17. Note three stars on nose indicative of regular use by a lieutenant general.

Capt. Hubert A. Thompson, San Antonio, Tex., a pilot with the Second Division air section since he came to the theatre August 19, claims that "were it not for the Navion we couldn't have kept the other light planes in the air. It was the only plane capable of bringing up spare parts when they were needed — and bringing them up fast."

Pilots during the Pusan perimeter days soon found that it was possible to load cargos as heavy as two L-4 engines in the Seventeen and carry them across the Japan Straits. In so doing they were obliged to maneuver across the expanse of water between Japan and Korea without the precaution of parachutes and "Mae Wests" because of the added weight factor.

During those same days, when the enemy had minimal air and anti-aircraft power, the Seventeen was used extensively for route reconnaissance deep over enemy-held territory because of its range (an average of 700 miles) and speed.

But its primary mission was the direction of Air Force fighter strikes in close support of ground troops. Principal reason for this critical use was the fact that the Navion carried Very High Frequency radios which could be netted with both ground troops and the attacking fighters, a characteristic not held by the L-4s and L-5s.



U. S. Army Photograph

The Ryan Navion L-17 has proved ideal for aerial route recannaissance deep over enemy territory in Korea because of its speed and range. Such missions contributed greatly in the two United Nations advances of last fall and again in January.

Maj. Howards Lukens, Anaheim, Cal., operations officer of the aviation section of EUSAK (Eighth United States Army Korea), pointed out recently that with the arrival in the theatre of Air Force mosquito squadrons which now direct air strikes the Navion has reverted to its fundamental function as the "drafthorse" of Army air in Korea. This becomes doubly true with the arrival here of the L-19 liaison plane, which like the Seventeen is equipped with VHF radio.

Although the Seventeen remains the best plane for long distance reconnaissance because of its medium range of five and one-half hours in flight at a cruising speed of 125 miles per hour, the emergence of limited enemy air activity and antiaircraft weapons have restricted this function, Major Lukens said.

The spokesman added that the Air Force, with specially designed aerial reconnaissance planes, has taken over this phase of friendly air activity, particularly as United Nations lines expanded further northward.

The nickname "drafthorse" has been applied to the Navion because of its ceaseless operations in the rear areas in the past few months in Korea. Seventeens are used principally as taxis for high ranking United Nations officers and selected staff members (an unofficial 'airline' has been in operation from strip to strip since last summer) and as a truck for emergency freighting missions.

Because of this latter function the gross weight of the Navion, fully loaded, has been raised after extensive testing by Army aviation officials from 2750 to 3100 pounds. On mercy missions the L-17 has been known to carry as much as 300 pounds of whole blood to a front-line medical aid station at one time.

(Continued on Page 16)

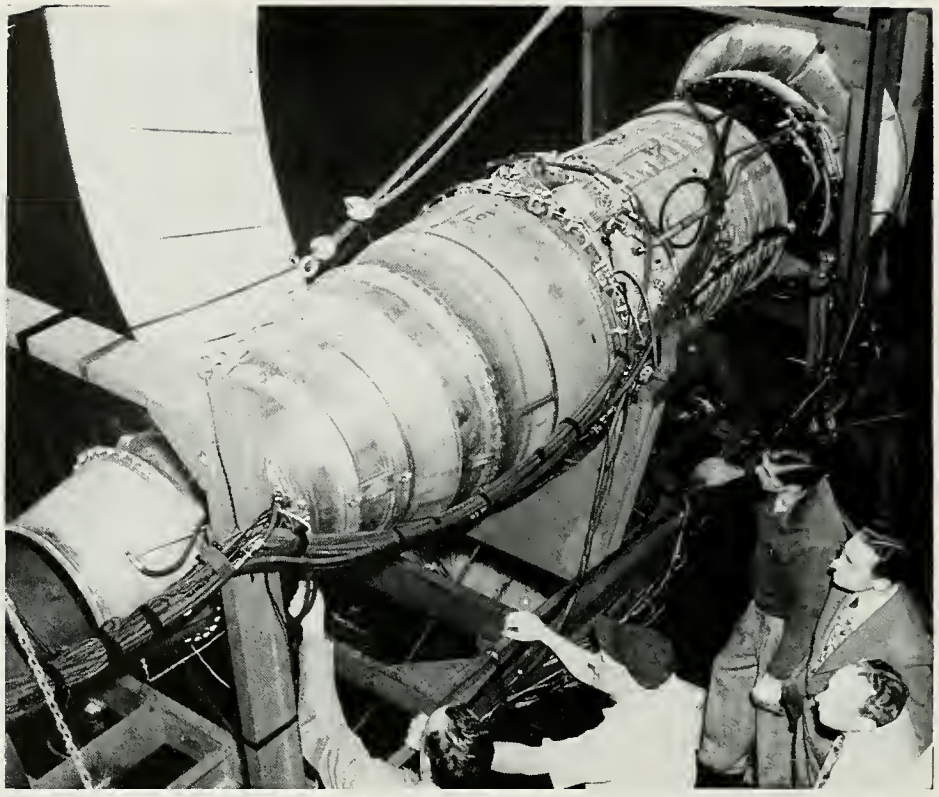
by Corporal David Stolberg,
Official U. S. Army Correspondent

A bright new jewel in the Air Force treasure chest of jet engines is the J-65 Sapphire, to be built by Wright Aeronautical Corp. in a manufacturing agreement with the developers, Britain's Armstrong Siddeley.

One of the world's mightiest turbojets, the Sapphire will power the Air Force's newest swept-wing fighter-bomber, the Republic F-84F Thunderjet, providing 7200 pounds of thrust, 2000 pounds over that of the previous engine installation. More rapid takeoff, faster rate of climb and higher speeds are anticipated.

The F-84F will outperform the "E" model which has operated spectacularly in Korea, where numerous enemy planes and many ground targets have felt its lethal sting.

The 7200 pounds thrust is equivalent to more than 13,000 horsepower at high speed. Although actual performance figures are restricted by military security, Roy T. Hurley, Wright Aeronautical Corp. president, points out that the Sapphire makes possible improved performance over the F-84E, which has a top speed of "over 600 miles an hour," a combat radius of 1000 miles with external wing tanks, and a service ceiling of more than 45,000 feet.



Most powerful turbo-jet in production, the J-65 Sapphire, is shown in test cell of Wright Aeronautical Corp., which is gearing its facilities for mass output.

Sapphire JET JEWEL

Powered by 7200-pound thrust Sapphire engine, Republic's F-84F Thunderjet shown climbing rapidly after takeoff in test flight over Edwards Air Force Base, Muroc.

"Installation of the Sapphire in the F-84," Hurley said, "brings to a battle-tried airplane a proven engine which will extend every point of the plane's performance. The increased power of the Sapphire, its greater fuel economy, and its improved ratios of frontal area and weight to output will increase even further the already outstanding performance of this versatile fighter."

To meet the heavy production demands, not only for the Sapphire, but for its piston-type engines, Wright Aeronautical Corp. has boosted its working force at Wood-Ridge, N. J. to over the 11,000 mark, an increase of 4,000 in the last year, and probably will add another 7,000 by the end of this year.

Military requirements will still exceed Wright's capacity, and to insure speedy deliveries, other manufacturers will be licensed.

(Continued on page 18)

New Jet Building →

CONSTRUCTION of a 75,000 square foot addition to its manufacturing facilities has been started at Ryan in another phase of the plant's expansion program. The large $300,000 factory structure will rise adjacent to the final and sub-assembly buildings and will provide needed production space for further enlargement of Ryan's already large jet engine components manufacturing schedule.

On completion of this new jet engine parts factory building late this summer, Ryan plant space will be increased to approximately 750,000 square feet.

More than $2,000,000 worth of new production machinery and other equipment, exclusive of special tooling and fixtures, will be installed in the new building. Of steel and stucco construction, it will be 250 by 300 feet,

(Continued on page 18)

Ryan's electrical needs in any further plant expansion will be met by new General Electric transformer, rated at 1500 KVA (kilovolt amperes) shown being unloaded.

MORE JUICE

New "substation" is equipped with 1000 KVA G.E. transformer and switching gear. Left to right are Al Auerbach, C. L. Lehton, Braxton B. Walker and W. J. Salmon.

"MORE juice!"

That cry echoed in Ryan's sub-assembly building last month as production of giant wing fuel tanks for combat planes was stepped up.

Workmen began the urgent task of supplying the "juice" — electricity required for additional spot and seam welding machines. Meeting production schedules depended on getting the "juice" into the factory on time. An entire new electric "substation" had to be equipped.

A trench, 1200 feet long and four feet deep, was dug along the main factory building to the west end of the sub-assembly structure, and north to the "substation," which has been set up in a one-time compressor room more recently used for storage purposes.

12,000-volt lead covered cable was buried in 1200-foot long trench.

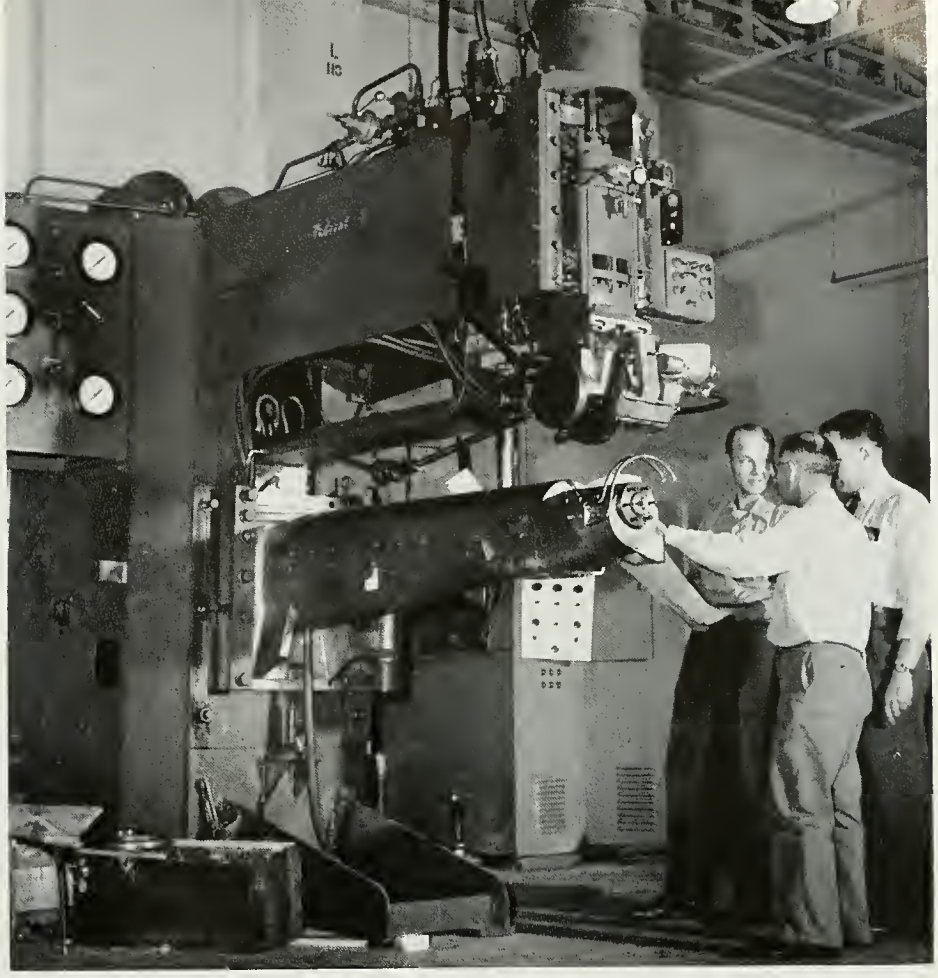
A 12,000-volt lead-covered cable, encased in concrete, was buried in this trench. Two large manholes, 8 feet deep and 6 feet square, were excavated — one at the west end of the main factory building, another at the southwest corner of the sub-assembly building. From these manholes, access will be provided for cable splicing and maintenance.

(Continued on page 21)

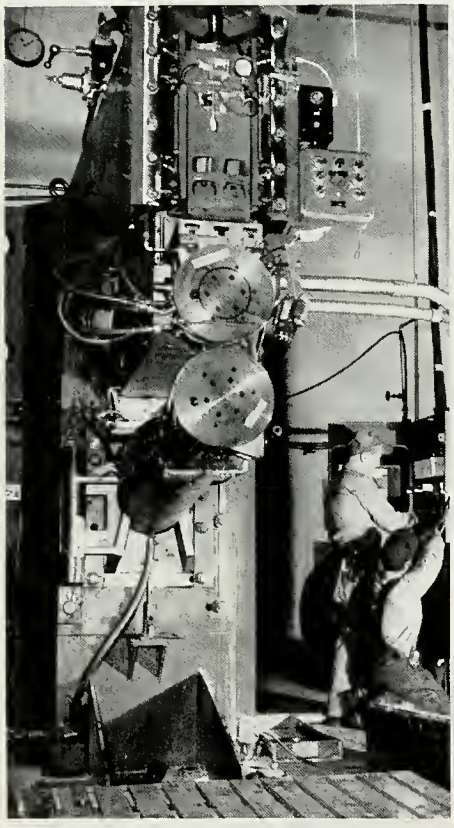
GIANT WELDERS

GIANT strides in maintaining its position as one of the nation's leaders in resistance welding fabrication are being taken by Ryan Aeronautical Company. Already equipped with 39 machines — 30 spot welders, 6 seam welders, 2 seam or roll spot welders and 1 flash welder — the plant is receiving additional special equipment which has been on order. Ten more welders will have been added by the time this appears in print.

Just installed is the newest resistance welder in the plant and the largest machine of its kind in the country — a combination spot welder, roll spot welder and seam welder. Three more seam welders are on their way.



Biggest welding machine of its kind in the country is checked by Ryan technicians following installation. This machine can perform spot, roll spot and seam welding.

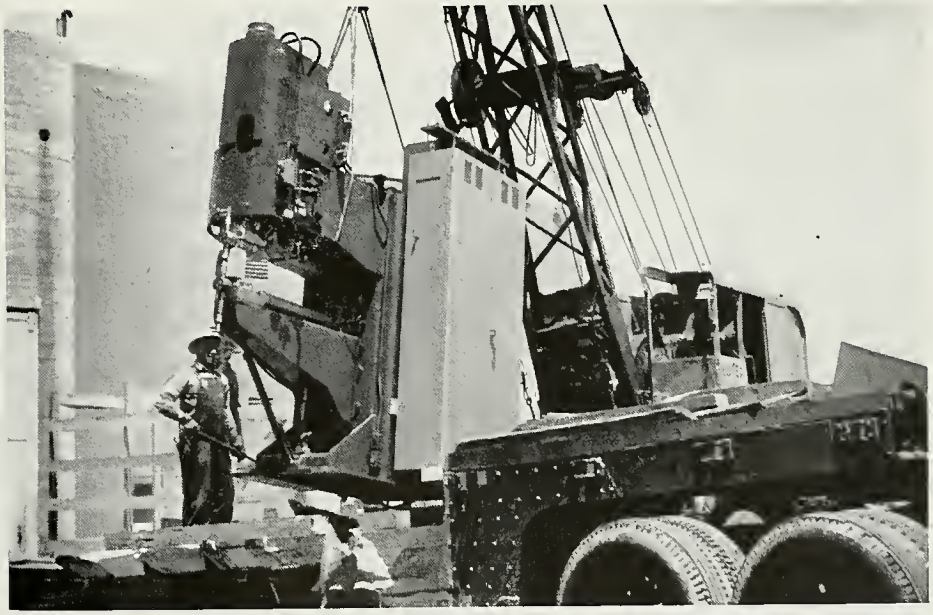


Power connection installation is made for giant welding machine.

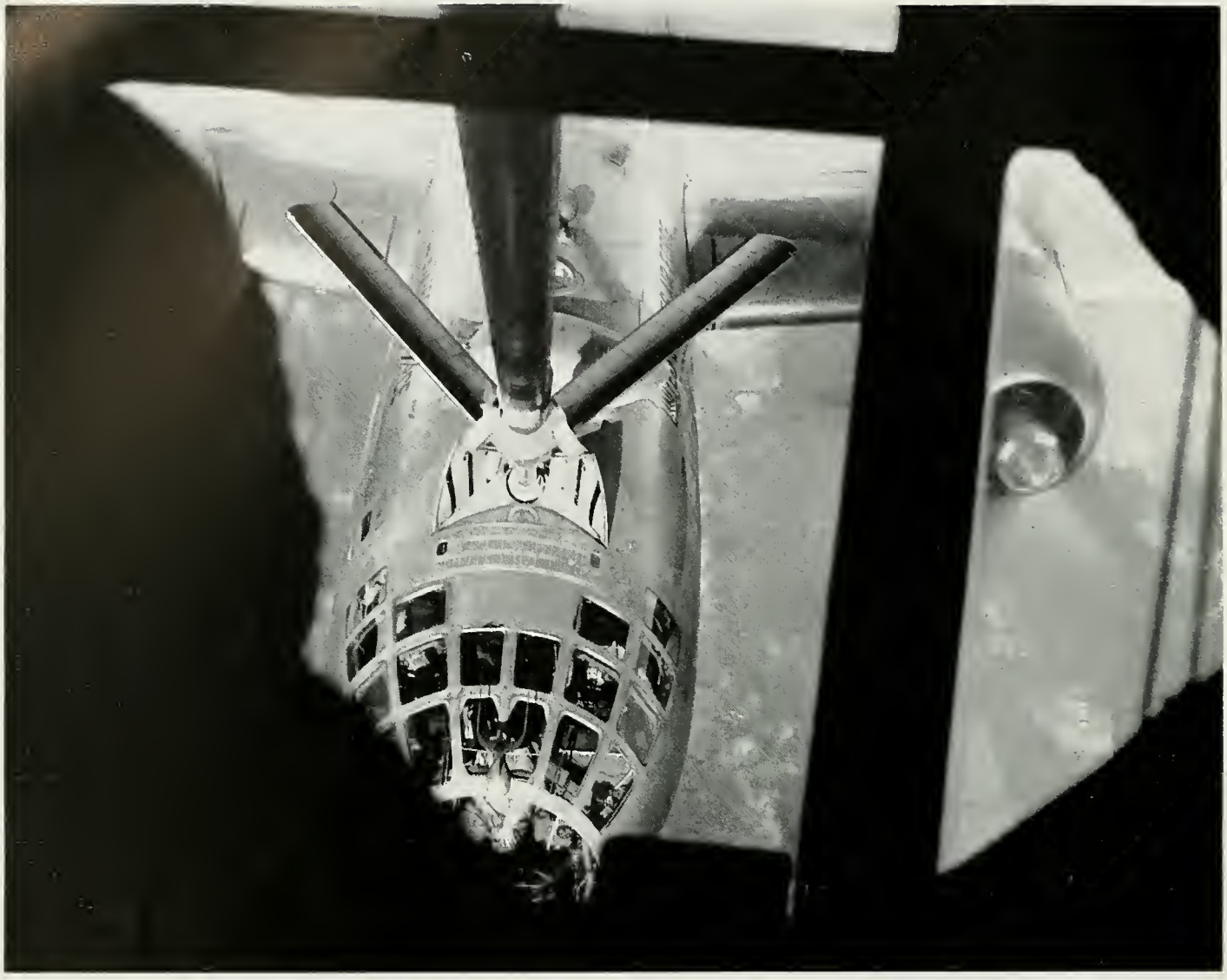
Manufactured by the Federal Machine and Welding Company of Warren, Ohio, to Ryan's specifications, the new machine can handle such heavy gauges as two pieces of 1/8-inch thick aluminum alloy, or two pieces of .156-inch Austenitic or nickel alloy, to an unusually great "throat" depth — 60 inches.

Its installation resulted in an immediately accelerated output of wing fuel tanks for combat planes, the largest such tanks known to be in production. Al-

(Continued on page 16)



Delivery of Thomson welder, built to Ryan specifications, enabled acceleration of output of combat plane wing fuel tanks, largest known to be in production.



Here's the view you get from the Boeing aerial tanker as "Clancy" lowers the boom to refuel B-50 Superfortress at 7,000 feet.

Over Clancy's Shoulder

SEVEN thousand feet above Puget Sound, you get an idea of the thrill a circus tight-rope walker must experience as you crouch in the tail of a Boeing KC-97A aerial tanker watching "Clancy" lower the boom.

"Clancy" is the steel-nerved crewman who lies prone in a pod slung beneath the aft fuselage and controls the rigid steel boom through which fuel surges from the tanker to a bomber — in this case, a Boeing B-50 Superfortress.

This is mid-air refueling at its most impressive.

The KC-97A is a regulation C-97 Stratofreighter modified into an aerial filling station. It has proved its worth as a tanker, but on this particular flight several items of equipment are being evaluated.

You're looking over the shoulder of "Clancy," whose name on the Boeing payroll is Bert Binegar. But "Clancy" probably always will describe the Binegars who handle this ticklish operation in the skies.

At 7000 feet altitude, you hear over the radio:

"This is Air Force 304. We're right behind you, closing in."

The B-50 comes into view. It's probably 50 feet below you and twice that far behind. Up here, that looks mighty close.

Binegar's voice comes through your headphones: "Boom operator to tanker pilot — stand by for boom checkout."

"Roger," answers N. D. Showalter, Jr., the tanker's co-pilot.

The boom is made up of two telescoping sections of pipe and is attached to the tanker's fuselage by a yoke and trunnion setup that permits movement. Now the boom goes out and down. Binegar controls its movement with a conven-

(Continued on page 21)

RYAN BUILDING REFUELING PODS

A multi-million dollar contract for refueling pods for Boeing KC-97 flying tankers has been received by Ryan Aeronautical Company and was announced last week concurrent with a statement by Boeing Airplane Company that additional Stratotreighters now being built for the U. S. Air Force will be quickly convertible for service either as transports or aerial tankers.

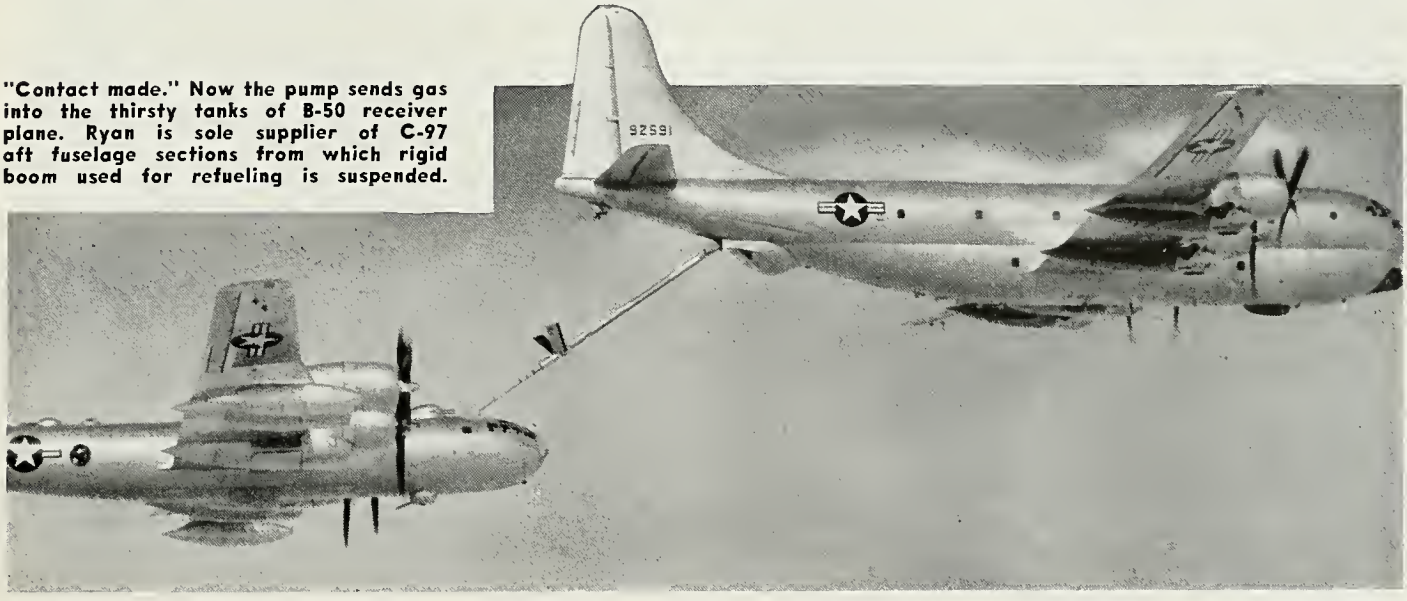
Deliveries of Ryan-built refueling pods have already begun and are scheduled to continue through 1952. For several years Ryan has been building the aft fuselage section and cargo doors for the C-97. Since the pods in the flying tanker version are designed to replace the cargo doors, Ryan was the logical source to also supply this equipment.

The gondola-like pod which houses the flying boom operator's station and is the fulcrum for the boom itself, is designed to fit exactly into the opening made by removal of the transport's rear clamshell cargo doors. It requires only six hours to change the double-deck military transport from its more-normal role as troop or cargo carrier to a Flying Boom tanker. Production models of the dual-purpose C-97s will leave the Boeing Seattle plant as tankers but will carry complete transport conversion kits including their Ryan-built cargo doors, seats and other equipment.

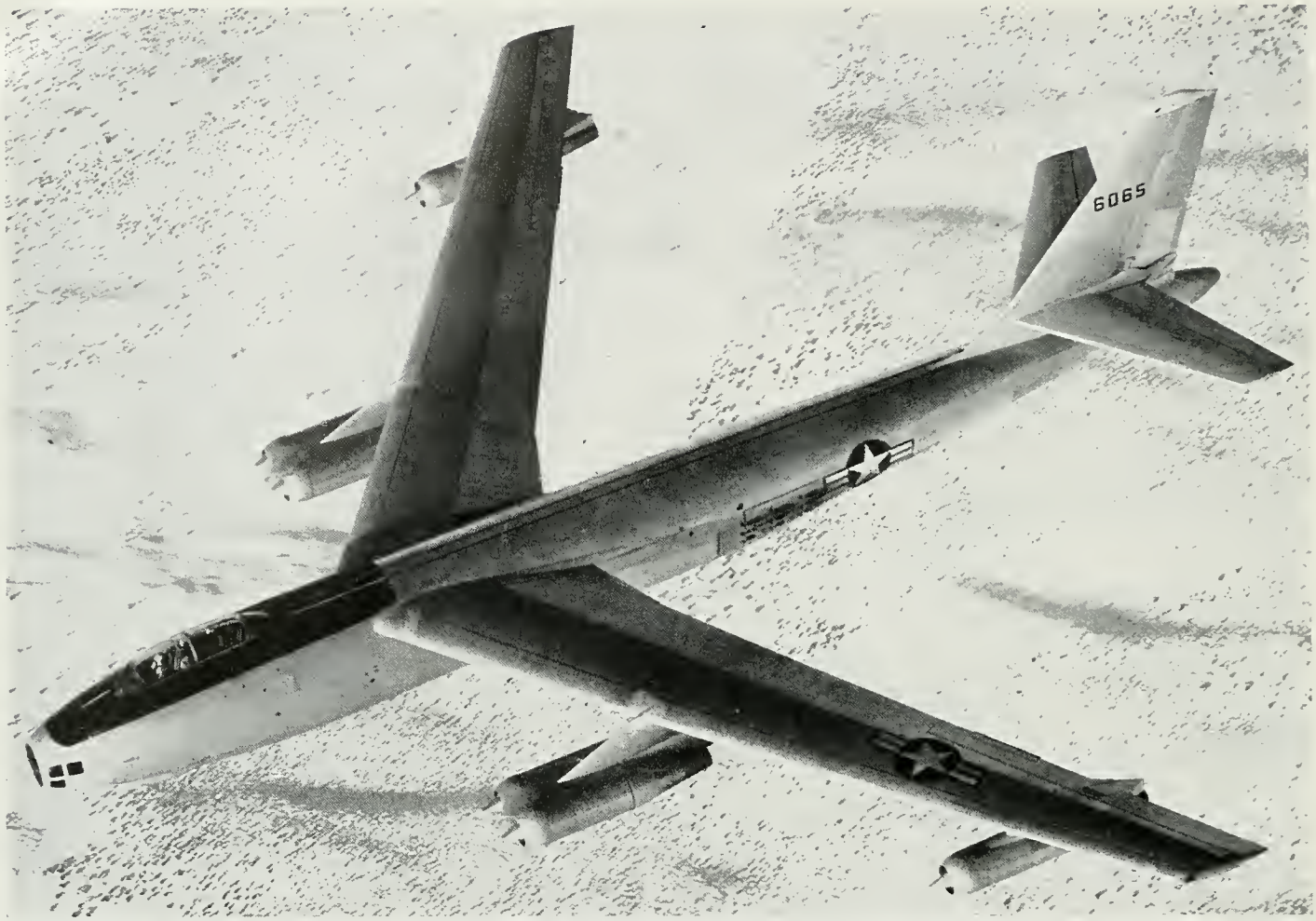
With one airplane able to serve the two functions of transport and tankers, the Air Force will be able to do both jobs with fewer planes, saving on initial cost, upkeep and manpower.

"Clancy" is Bert Binegar, left, flying boom operator, shown with Marv Michael, pilot of receiver plane, beneath pod in which "Clancy" lies.

by Reynolds Phillips, Staff Writer, BOEING Magazine

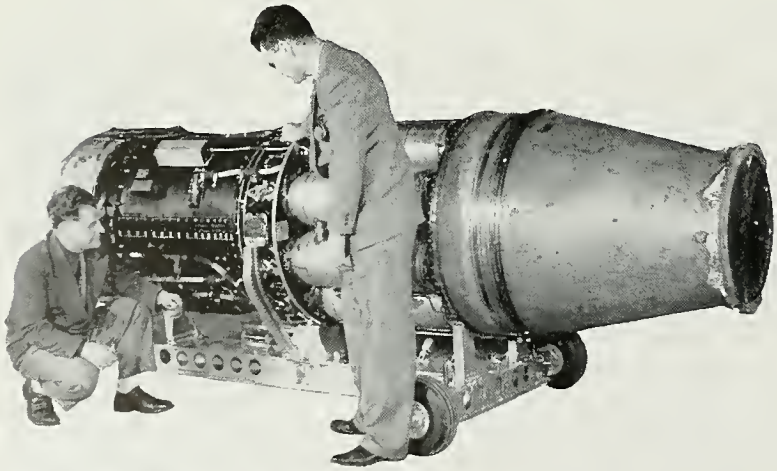


"Contact made." Now the pump sends gas into the thirsty tanks of B-50 receiver plane. Ryan is sole supplier of C-97 aft fuselage sections from which rigid boom used for refueling is suspended.



Boeing's 600 m.p.h. B-47 Stratojet plays a leading role in today's program of an expanding Air Force for American defense.

DOUBLE 47



Co-star in the story of "Double 47" is the General Electric J-47 jet engine, which powers the six-engine B-47 bomber.

"47" HAS become the important number to watch in America's rearmament effort, with three of the nation's biggest aircraft companies — Boeing, Douglas and Lockheed — committed to a giant production program for the Boeing B-47 Stratojet Bomber. Too, manufacturers from 26 states are combining facilities to produce components for General Electric's powerful J-47 jet engine, six of which power each of the 600 mph bombers.

The correlation between the Boeing B-47 and the General Electric J-47 is much more than similarity of number designation, for the J-47 jet engine powers the six-engine Stratojet, and as B-47 production is stepped up in coming

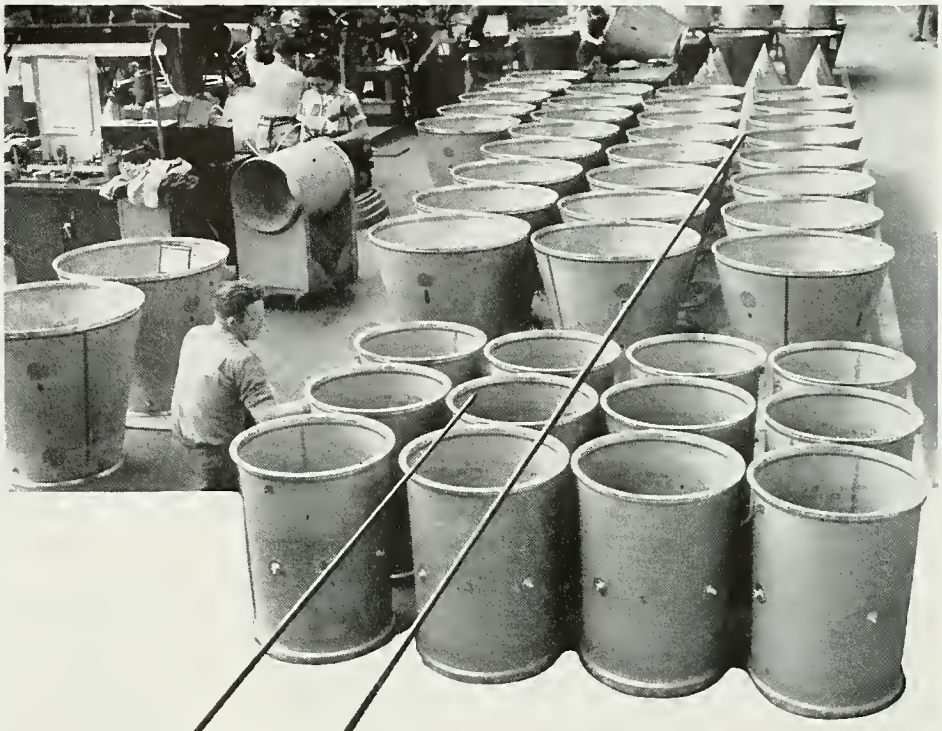
months, manufacture of J-47 engines must increase markedly.

Add to these production requirements for the B-47 the needs of the North American F-86D Sabre interceptor and the intercontinental Convair B-36 Bomber, which are also powered with the J-47, and the prodigious production plans for the J-47 become evident.

To meet the increased demands for exhaust cones, inner and outer combustion chambers, transition liners and other Ryan-manufactured J-47 parts, the company's jet engine division is greatly expanding its operations. One entirely new 75,000 square foot building is being erected to house $2,000,000 worth of new machinery acquired for more jet engine production. Larger numbers of skilled workers have also been assembled and vast stores of materials readied to make the way clear for greater emphasis on "Double 47."

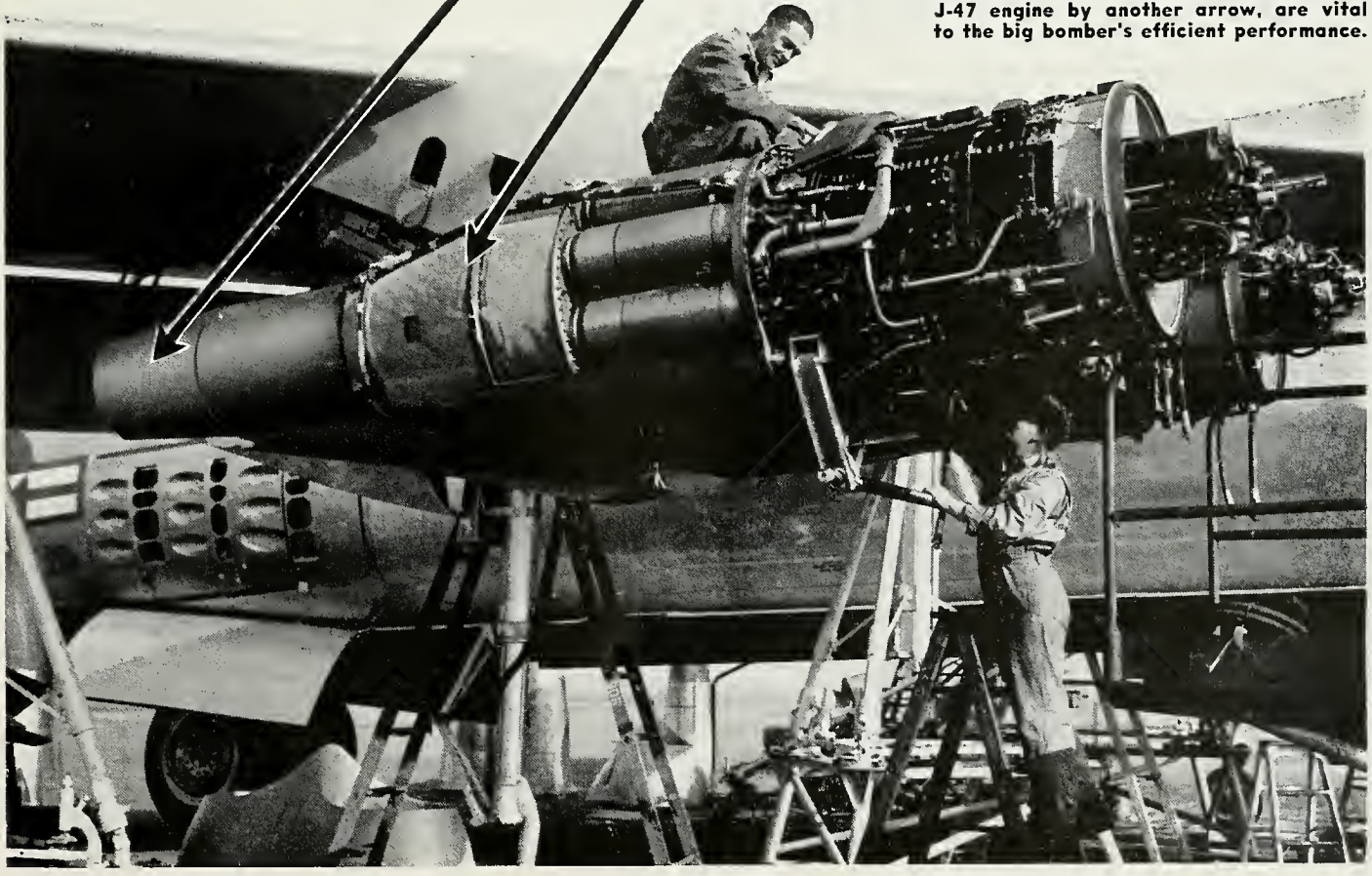
Long a major source of supply for parts and assemblies for each of the "big three" plane-makers of the Stratojet program, Ryan is today one of the foremost sub-contractors for the B-47. Regular shipments of Ryan stainless steel tail-

(Continued on page 17)



Arrow far left shows how Ryan stainless steel tailpipes are important elements in the jet pods of the B-47 Stratojet.

Inner and outer cones, linked to the GE J-47 engine by another arrow, are vital to the big bomber's efficient performance.



Shot under a suspended lead punch, this operator's view shows some of the stamping facilities in Ryan's forming department.

3000 POUNDS TO THE DROP

Robert Murray raises heavy lead punch from feeder die developed from idea suggested by employee.

Employee ideas help double metal parts forming production

EFFICIENCY in forming stainless steel stampings for Ryan exhaust systems for piston-type engines has doubled since the war years due to intense concentration on improving methods in the Drop Hammer department. More than 7 parts per manhour are being formed today compared with 3.8 parts — which was considered a high production rate during World War II. Back of this achievement is an interesting story on improvements resulting from suggestions by the men on the machines.

Drop hammers are unusual tools in that they are the only machines which satisfactorily form compound curves and sharp radii in tough, heavy gauges of corrosion-resistant steel. It takes impact to form the Ryan aircraft exhaust systems of these metals because of their strong tendency to "spring back" when formed. Heavy presses will not do the job. Keen judgment and expert handling are required on the part of the operators in using the 3,000 pound hammers of these forming tools. A man has to "feel" the metal flow around the die as the big punch forces it into shape; and it takes from three to four years to obtain real proficiency in the work.

Adolf Bolger, night superintendent of fabrication, and Owen Walker, Jr., drop-hammer foreman, wisely estimated that the best way to improve production was to encourage the men on the machines to come up with new ideas for doing the work better, faster and more economically. They felt that the men closest to the actual work can see improvements first.

One of the first employee suggestions was Louis Speier's idea of adapting a "feeder die" to the forming of the Boeing B-50 exhaust system outer stampings which were then being formed in a series of individual dies in stages. Now one long die incorporates all the forms of the other dies in one continuous shape. The Boeing parts were pushed along the contours of this die and drop-hammered in successive stages to emerge in the required form. This not only eliminated the extra dies formerly used but stepped up production from 125 parts in 13 manhours to 1250 parts in the same 13 manhours — an increase of 1000%. It was quickly adapted to the fabrication of other types of work such as the Fairchild C-119B components.

Another operator idea was to place locating pins or drill rods in the dies to locate the position of the parts. Called "pre-positioning," this technique allows the operator to accurately provide for one-half inch of flange, rather than have to guess at the result. Pre-positioning makes it possible to eliminate extra operations of sawing and rough trim, permitting the parts to go directly from drop hammer to degreasing — saving time and expense.

Further streamlining resulted from the suggestion that a water-soluble oil be sprayed on the parts, to lubricate them, instead of brushing on the heavy oil previously used. This heavy oil had to be removed in a trichlorethylene vapor bath type of degreaser which cost hundreds of dollars a month to operate. With water soluble oil, the lubricant can be quickly removed in a warm alkaline bath which costs only $200 a year to maintain.

Only by the fullest utilization of both the highly skilled operators and the drop hammers could real production efficiency be achieved. This was fully demonstrated when parts handlers were assigned to relieve the skilled operators of all incidental tasks. Parts handlers spray on the lubricants, dry the parts prior to degreasing and handle them between each operation. A corollary of this improvement is the handling of all parts in the minimum number of corrosion-resistant baskets which can successively be placed in normalizing ovens, pickling baths and

(Continued on Page 17)

Jerry Sklar controls the fast-moving action of the Cecostamp by means of a hand-operated lever which simplifies forming machine supervision.

Drop hammer punches are cast by pouring molten lead directly into the Kirksite dies in the Ryan foundry where all forming dies are poured.

Dutch colonial fliers in the Netherlands East Indies had been training in these Ryan STM's for several months when the Japanese launched Pearl Harbor attack.

"I TRUST A RYAN FOR TOUGH JOBS"

by John H. Russell, Managing Director, Air Djibouti, Asmara, Eritrea

IT seems that no matter what part of the world I happen to be in, Ryan planes play an important part in my life.

More than ten years ago, before the Japanese attack on Pearl Harbor, I was one of a group of American fliers under contract to the Dutch colonial government to train military pilots in the Netherlands East Indies. The training was performed in Ryan STM's which arrived from the Ryan factory early in 1941.

As I write this in the spring of 1951 in San Diego, I have just taken my first flight in a Ryan Navion Super 260, a plane I feel would be ideally suited for the unusual demands on an aircraft in the Middle East. I hope to acquire a Navion for Air Djibouti's chartered flights on fields ranging from 8,000 feet altitude at our base at Asmara, Eritrea to sea level at Dhahran, on the Persian Gulf.

It flies so much like a big ship (I'm accustomed to the C-46 Curtiss Commandos our airline uses), that I am convinced the Navion would be a valuable addition to our fleet for carrying small groups.

Its excellent rate of climb would enable us to reach our high altitude base at Asmara with no trouble, and its unbelievably short landing characteristics would get the Navion in and out of the rough fields we encounter with plenty of room to spare. We could maintain airline

Recalling pre-Pearl Harbor days, this pilot has good reason to rely on ruggedness of planes produced by Ryan

schedules more economically through use of the Navion on flights of two or three passengers, now requiring the big Commandos.

Navions are not strangers to the Middle East. On our runs out of Dhahran two mornings a week for Air Djibouti, which is a division of Transocean Air Lines, I usually see two or three Navions ready to take off on the "pipe line patrol" from the Persian Gulf to the Mediterranean.

These are part of the fleet owned by Arabian-American Oil Company not only for aerial inspection of the pipe line across the desert but to supply the isolated communities at the eight pumping stations along the line—communities that depend entirely on airlift for survival.

These planes operate under the most adverse conditions, in heavy sandstorms and in heat which goes up to 130 deg. F. in the summer months. Refueling is done on paved runways in the open desert at the pumping stations. They have more than earned their keep, replacing the slow Arab foot patrols formerly sent out to locate damaged sections.

Along the Russian-Iranian border, the Royal Iranian Aero Club operates two Super 260's which I have seen at Teheran and at Zahedan (the latter during a charter pilgrimage flight on which one of our Commandos carried Moslems fom Kabul, Afghanistan to Mecca.) These planes are used by the Iranian government not only to teach sport flying, but to deliver the mail to remote settlements in that rugged country of weather extremes, from terrible heat to snowstorms.

On my occasional trips into Nairobi, Kenya Colony, the big jumping-off place for African hunting safaris, I have seen Navions which are operated on charter from the Nairobi-West Airport and which seemed to be booked for big-game safaris two or three weeks in advance.

And one of the wealthiest young men in the world, 24-year-old Carlos Aridas, flies all over the Middle East in his Navion from his home in Beirut, Lebanon.

A plane like the Navion could perfectly cope with a situation peculiar to Eritrea. In mountain fastnesses of this country are roaming bandits of the feared Shifta, who swoop down on travellers to kill and rob them. Traffic between Asmara and villages in the interior must be heavily guarded, and even the greatest precautions are sometimes unavailing.

Our C-46's are too large to negotiate the small landing strips in the village—airports protected by police. A Navion, with its remarkable short landing characteristics, could commute regularly between Asmara and the villages—flying over the Shifta with persons who have business to transact in the danger zones.

I have reason to trust a Ryan product to do a tough job. Early in 1941, after the Navy released me as an ensign flying patrol bombers to train PBY pilots for the Dutch colonial government, I went

(Continued on page 20)

This low-flying Ryan Navian is one of fleet which guards 125-mile Trans-Arabian pipeline that ultimately will extend from the Persian Gulf to the Mediterranean.

GIANT WELDERS

(Continued from page 7)

though the welder will be used primarily for this project, it also will do work for the experimental and manifold departments, and on heavy jet engine components.

Soon after arrival of this huge machine, two others — only slightly smaller — were added to the rapidly expanding electrical welding facilities at Ryan. They are spot welding machines, built by Thomson Electric Welder Company of Lynn, Mass. Their throat depth is 48 inches, and maximum pressure at the electrode is 7300 pounds. They are guaranteed to weld two aluminum alloy pieces as thick as .102 inch each.

In contrast with the machines in the plant depending on single AC current or electrostatic stored energy, the new welders are 3-phase to single phase frequency converted type equipment, providing a more balanced load across the power supply and greater versatility for difficult welding jobs. They will be able to handle both aluminum and steel.

An idea of the power output of the new Federal Welder can be noted from the fact that its maximum is 105,000 amperes at the electrode on short circuit. Hand arc welders are operated at only 50 to 75 amperes.

The maximum electrode pressure at 80 pounds line pressure is 9100 pounds, almost twice the pressure of the next largest roll-spot welder in the plant.

One of the Ryan-specified features is aimed at guaranteeing safe operations. In the firing mechanism, the current is unable to pass until a predetermined pressure is developed on the electrode.

Another unusual control applies to seam welding. The first spot is made at reduced heat to avoid damage to the material, after which normal heat is automatically provided. This overcomes the tendency to overheat the first spot, occasionally resulting in excessive penetration of the weld nugget.

THE weld size is firmly controlled by contoured wheels, and the wheel electrode is continuously "dressed" to avoid the time-consuming necessity of sending it to a lathe for turning, previously a requirement — usually after every 4 hours use.

Two swinging arms, one for longitudinal and one for circular seam welding, are another valuable time-saver and safety feature. Without them, a crane would be needed to change the set-up of the machine.

Special spot weld adapters are provided for removing the wheel electrodes and installing standard spot welders with tips instead of wheels.

The machine has internally cooled wheels for seamwelding of aluminum alloys and provision for "flood" cooling of wheels when welding steel.

A special General Electric control panel has tap switches for changing the heat. One of the major features of this panel is its fixed increment heat control, making certain that specific power output can be duplicated exactly in the control settings.

Just before press time of the "Reporter," two Thomson seam welders, of 48 inch throat depth, and one Federal spot welder, of 60 inch throat depth, arrived at the plant. All this new equipment will be used primarily for welding operations on the giant wing fuel tanks.

To furnish the greatly increased power requirements of the battery of welding machines, Ryan has augmented its electrical system by installation of a new underground cable, six large secondary distribution lines and a complete substation capable of supplying 1,000 KVA (kilovolt amperes) at the required potential.

IT'S A WHOPPER

The largest single container at Ryan Aeronautical Company has been installed just east of the revamped Receiving Building.

It's a 10,000-gallon butane gas tank specially fabricated for Ryan by the American Pipe & Steel Company. The steel tank weighs 30,000 pounds, is 7 feet in diameter and 43 feet long.

Installation of the tank will change Ryan's method of butane gas storage. In the past, two 3,000-gallon tanks were maintained underground on Lindbergh Field near the flight control tower. The new tank is above ground.

Besides providing greater capacity, the tank will permit a more efficient flow of gas and will be simpler to keep in good repair than the underground tanks, which required excavations every two years for inspections prescribed by law.

Butane gas is used at Ryan as a booster for its natural gas supply.

FRONT-LINE "AIRLINE"

(Continued from page 3)

Maintenance-wise, airmen in Korea credit the Navion with greater fortitude against the vicissitudes of weather, the bumpy dirt airstrips (which have been fashioned from race tracks, rice paddies, mountainsides and ox trails) and the incredible conditions of thermals created by the peninsula's mountainous terrain, than any of the two-place planes.

Sergeant First Class Clarence R. Flowers, Newton, N. C., Second Division maintenance chief, is particularly impressed by this factor. "All of us thought that the Seventeen was good for operating out of Stateside strips and that was all. We found out differently over here," Flowers said. "The pilots have learned they can do more with that ship than they ever dreamed of, and my crew chiefs have learned that it gives us less trouble than any other light craft out here."

Flowers and other maintenance men are backed in their respect by Capt. William H. Gardner, EUSAK Ordnance Aircraft Officer. Gardner flatly states that the "Navion has no bad qualities" in this respect. Particularly this is true as far as dust conditions go, he says. "Our other craft have given us endless trouble there. Filters have to be continually cleaned, overhauled and replaced. We haven't had any trouble of that nature with the Navion."

Another pilot with the Second Division, Capt. William G. Blake, Selma, Cal., said that the Seventeen "came through when we needed it and put it to missions for which it was not intended last summer and fall. No other plane over here can do the job that's needed in our friendly areas so well."

Blake further credits the Ryan-built Navion 'B,' or current Army model, as the plane that "sold people in the Army on the role of light aviation. When the brass found out that light aircraft could provide comfortable riding at what they thought was a good speed the Army really became light air conscious."

The Navion, a product of the Ryan Aeronautical Company, is the only multi-passenger Army plane in the zone. That it has played an important role in the campaign has become increasingly evident.

New Triple-Purpose Machine for Tool Manufacturing

Another massive multi-purpose machine tool of high precision has been added to the facilities of Ryan's tool manufacturing department. First of its particular type to be used by Ryan, it carries the lengthy name of Horizontal Boring, Drilling and Milling Machine and is the product of the Giddings and Lewis Machine Tool Company of Fond Du Lac, Wisconsin.

Designed with an unusually large bed and open-type structure, it is especially suited for handling large, unwieldy and odd-shaped castings or fabrications. With its wide flexibility, it can be efficiently used on single pieces, short runs or quantity production.

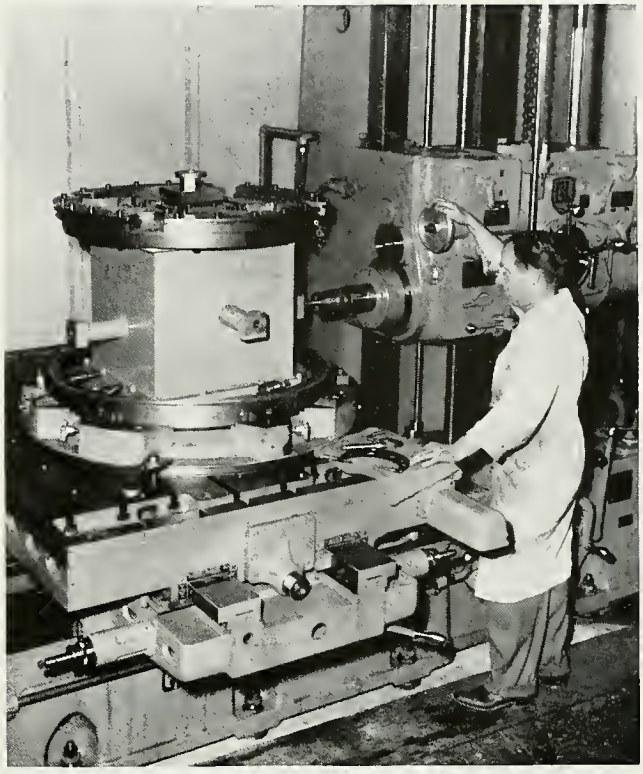
According to Paul Sauter, tool manufacturing supervisor, the Giddings and Lewis machine "brings increased capacity in three types of metal cutting to our department and gives us a new opportunity to substantially reduce costs on machining large tools. For instance, formerly it took approximately 40 hours work to drill and bore the exacting positioning holes in the General Electric J-47 jet engine tools for the tail cones. We had to locate the drill points by hand, using temporary drill templates and a calibrated scale because of the large size of the tooling. Now, we simply place the G. E. tool in our new machine and locate and drill the holes using the fine precision scales of the machine itself. This has reduced the time for this operation from 40 to 8 hours."

Weighing 19,000 pounds, the H.B.D. and M. Machine has the necessary size and weight to insure extreme precision on work over a large area.

Typical production type jobs performed on the new machine are the combination boring and milling of large case and duct weldments for some of the most powerful jet power plants ever developed.

Representing an investment of $31,500, this latest addition to Ryan capital equipment promises to return many times that amount in labor-saving and cost-cutting premiums.

COVER PICTURE



DOUBLE 47

(Continued from Page 11)

pipes for Stratojet engine pods will soon be rolling to Douglas' recently reactivated operation at Tulsa and the Lockheed factory in Marietta, Georgia, as well as the Boeing plant in Wichita. Tailpipes for the B-47 also go to Bell plants in New York and Texas which assemble the complete "pods" not only for the B-47 but also for the B-36.

The coordinated program for producing the B-47 is reminiscent of the production pools during World War II, when the Boeing-Douglas-Lockheed group combined efforts to produce a total of 12,731 Boeing-designed B-17 Flying Fortresses.

Col. Harley S. Jones, the Air Force's B-47 Field Project Officer, directs the liaison and coordination program for the massive Stratojet production program. Liaison chiefs for the three prime contractors are: Lee Howard, Boeing Airplane Company; Robert I. Mitchell, Lockheed Aircraft Corporation, Georgia Division; and Larry G. Sebring, Douglas Aircraft Company, Tulsa Division.

Brig. Gen. O. F. Carlson has been assigned as special assistant to the Chief of Staff of the U. S. Air Force for the B-47 (B-52) program.

3000 POUNDS TO THE DROP

(Continued from page 13)

so on. This eliminates the need for taking parts in and out of containers and conveyors. These developments have reduced handling of parts by two-thirds. The savings in time and money can be appreciated when it is realized that the parts must go through between 14 and 18 separate processes and four stages of forming in the Drop Hammer department.

Ryan tool planners and the development laboratory have contributed to more efficient production by a standardization program which simplifies all scheduling of parts. Tool planning cards and parts traveler cards are simplified to show key numbers for the tools and processes required for each batch of parts. These key numbers tie in with a manufacturing process data brochure which the development laboratory devised to show the detail for a list of standard processes. Now, parts handlers can read the easy-to-understand figures on traveler cards and refer to definite specifications for any detailed data.

Ryan supervisors are also routing more work through punch presses where light weight, one-hit forming can be done, instead of taking up drop hammer time. New machines, such as the Cecostamp, are also being added to Drop Hammer facilities to obtain greater efficiency. The Cecostamp is an air-driven hammer which is operated by a lever that follows the movement of the hammer and can be actuated to produce delicate degrees of impact. It eliminates much of the fatigue connected with forming by relieving the operator from using the rope of the conventional drop hammer.

Forming authorities believe that rope hammers will always be used, however, in the forming of light gauge metals because the operator actually has to "feel" the impact of the hammer in order to get the best results with these materials.

Ryan has pioneered in the adaptation of the drop hammer to the needs of the aircraft manufacturing industry, installing the first group of Ryan-designed machines in the late thirties. Since then Ryan's prominence in the field of exhaust system fabrication and the wide utilization of corrosion-resistant steels in these components, has provided the company with a wealth of know-how in the forming of these modern metals.

SAPPHIRE JET JEWEL

(Continued from page 4)

One of the engineering problems is the conversion of Sapphire parts drawings from English to American standards. To assist in this project, about 12 British engineers have been sent to this country.

Wright hopes to be able to produce the Sapphire in half the time required under the British methods of fabrication. Production emphasis will be on machine accuracy rather than skill of the operator. Being determined is how much the extremely fine British tolerances can be liberalized without adversely affecting the engine's performance. For this purpose, simultaneous test block runs have been performed on British and American-built Sapphires.

With actual production due to get under way this summer, schedules projected into 1952 are understood to call for an output of several hundred a month by next year. This will be done at the Wood-Ridge plant without slowing down work on Wright's R-3350-30W Turbo-Compound, the combination piston and turbine engine being built for the Lockheed P2V-4, the Super Constellation, the Martin P5M and the Fairchild C-119C.

Approximately 1600 machine tools for the Sapphire are being added to the 3000 which have been at Wood-Ridge for piston engine production.

When manufacturing operations are going full blast, Wright's production of the Sapphire and Turbo-Compound will amount to more units per month than at any time even during World War II, when 750 Cyclone 18's were turned out every 30 days.

And while mass production is being mapped out, Wright engineers are proceeding with a development program to increase the Sapphire's performance beyond its present 7200 pounds thrust.

Power undreamed of a few years ago will be furnished by this great turbo-jet, product of a partnership of British and American engineering and production know-how.

Output of Wasp Major exhaust systems will accelerate through use of new portable spot tack welder, at left, and rocker arm seam welder, at right.

Assembly Line Set-up for Wasp Major Exhaust System

Tooling is being arranged on an assembly line basis at Ryan for mass production of exhaust systems on one of the most powerful piston engines ever built—the Pratt & Whitney R4360-53 Wasp Major.

The production line is being set up in the main factory building, where prototypes and first production units have been completed. Output will be gradually accelerated during the next few weeks.

The Wasp Major is the engine which powers the Boeing C-97 Stratofreighter, Boeing 377 Stratocruiser and Convair B-36 intercontinental bomber. Newest models of this engine, for which Ryan is building exhaust systems, incorporate several improvements.

The new exhaust systems will be mounted on the engine to be delivered to the airframe manufacturer as a complete "package." Previously, the exhaust systems were structure-mounted on the engine by the prime airframe contractor.

Two big new welding machines have been installed on the Pratt & Whitney assembly line—a rocker arm seam welder on which all collector and header flanges are seam-welded, and a portable spot tack welder which assembles the flanges to the collector or header bodies in the jigs.

Informally attired, San Diego's new mayor, youthful John D. Butler, is shown at controls of Navion after his first flight as chief executive. Standing is City Manager Compbell.

"FLYING MAYOR"

When San Diego's new "flying Mayor," 35-year old John D. Butler, made his first plane flight on official city business, he piloted the aircraft of his personal preference —a Navion.

Butler was at the controls of the rented Navion on an overnight trip to Sacramento and return. He was accompanied by other city officials, including City Manager O. W. Campbell, on the flight, which was approved by the City Council.

The jaunt attracted nationwide attention, as Butler put into practice his ability as an aviator perfected during World War II, when he was a Navy flier.

NEW JET BUILDING

(Continued from page 5)

and will be located at the west end of Ryan's 40-acre plant site on Lindbergh Field.

Present plans call for the new factory to be used exclusively for the manufacture of combustion chambers, exhaust cones, tailpipes, exhaust nozzles, afterburners and other precision-built stainless steel components for jet engines.

Ryan's largest current production is for General Electric jet engines, but the company also is an important supplier of jet engine parts for Pratt & Whitney, Westinghouse, Allison, Wright Aeronautical and others.

Equipment on order for the new building includes the latest precision machinery, heavy presses, extensive welding apparatus, annealing ovens and other facilities for stainless steel fabrication.

Metal Products Division Opens Office at Dayton

Ryan Aeronautical Company's growing metal products business in the Midwest has necessitated opening a full-fledged office in Dayton, Ohio with John Atha in charge. The office is in the Third National Building.

R. Offenberg

Assisting Atha in servicing the Middle West Territory is a newcomer to the Ryan organization, Richard J. Offenberg, formerly supervisor of estimating for Curtiss-Wright Corp. and North American Aviation at Columbus, Ohio.

Jack Lucast

They will perform liaison with the Air Force Materiel Command at Wright Field, Dayton; the General Electric jet engine assembly plant at Lockland, Ohio; several plants in Detroit, becoming an increasingly important aircraft production center; and other factories as far east as Buffalo, and west to St. Louis.

Paul Myers

The new Southern California field representative of Ryan's Metal Products Division is Jack Lucast, who joined Ryan as an hourly paid aircraft mechanic in 1947. He was promoted to the post formerly held by Jack Zippwald, now assistant to Sam C. Breder, customer service director.

Paul I. Myers, recent graduate of the Stanford University Law School, is a new contract analyst in the customer service department.

Officer Students to Study Ryan Guided Missile Work

Approximately fifty officer students of the armed services Guided Missiles School at Fort Bliss, Tex., will visit the Ryan plant June 15 in an all-day session coordinated by Robert Shaver, preliminary design engineer, and Jack Glines, executive assistant.

This is the second tour of its kind at Ryan this year. The officers are members of a graduating class completing its instruction by first hand inspection of guided missiles projects in various plants.

This imposing line of Navions pictured at Van's Air Service in St. Cloud, Minnesota, was all part of a day's inspection work for "Doc" Sloan, Jack Lucast and L. J. Holland, Continental Motors representative, during last year's service clinic. B. G. Vandre, standing, is Navion distributor for North Central states.

Nationwide Navion Sales and Service Tours For 1951 Started in Southwest; Pacific Coast Next

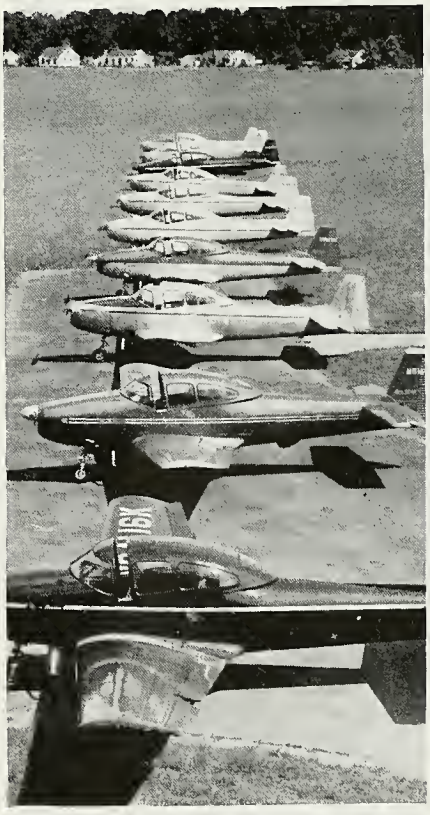
William P. "Doc" Sloan, sales demonstration pilot and Assistant to the Vice President, and Walter K. Balch, Airplane Service Manager, have completed the first of a series of six three-week Navion service clinics scheduled during 1951 throughout the United States. The initial tour took them through Texas and Louisiana.

A. P. "Pete" Gailey, representative of Lycoming, manufacturer of the Super Navion's 260 h.p. engine, and William H. Fate, Vice President of General Aeronautics, Texas Navian distributor, accompanied the Ryan executives during their trips to give free ground and air checks of Navions.

More than 800 flight hours were logged in a similar series of "clinics" over a six month period last year, during which Jack Lucast, Navion Field Service Engineer, and L. J. Holland of Continental Motors were also members of the inspecting party. In this time more than 400 Navions were inspected, flown and analyzed.

The 1951 inspection service promises to be every bit as beneficial to owners, distributors, mechanics and the Ryan Aeronautical Company as last year's popular program. Copies of the team's reports are regularly analyzed by the company's engineers with a view toward future improvement of the plane. Several features of the '51 Super 260 had their origin in information obtained by Sloan and party during the 1950 trips.

The next leg of the new series is along the Pacific Coast. In order thereafter are trips through the Rocky Mountain and Great Plains States (July); Atlantic Coast and Deep South (August); Eastern States (September); Central States (October).



This scene at Navion distributor Bill Eberhart's Louisiana Aircraft at Baton Rouge is a typical example of the scene to be found at any stop on the inspection tour throughout the United States.

NEW NAVION PARTS BUILDING

Rapid progress is being made in construction of the new 14,000 square foot Navion warehouse-hangar at the east end of the Ryan plant. When construction is completed, this will concentrate Navion spare parts supply and service in one area. Since completion of the 1951 Navions, a considerable volume of spare parts work has been carried on in the factory to bring the supply of spares up to the quantity owners will require through 1952. In the future, most of the assembly work for both commercial Navion and military L-17 spares will be done in the customer service hangar. The present supply of spares and purchased parts, such as complete engines, is valued at several hundred thousand dollars. This stock will "keep 'em flying" during the period of factory concentration on military production.

"I TRUST A RYAN FOR A TOUGH JOB"

(Continued from page 15)

to the naval air base at Sorebaja, Java, and found that the PBY's had not arrived. Ryan STM land and seaplane trainers had, however, just arrived from San Diego and were being assembled. The training was switched to the STM's.

In those rugged planes, we trained Dutch pilots who had escaped Hitler's advance into Holland; half castes, of Dutch-Javanese parentage, Chinese and Javanese.

Many of our students graduated into combat flying from STM training so fast it was unbelievable. Two of our students raided the Japanese base at Davao in the Philippines soon after the war broke out, and sank an enemy destroyer.

WHEN hostilities began, the landplane STM's were flown inland from Sorebaja by student pilots, some of whom had as little as 3 hours solo time, and no cross-country instruction. Poor navigation caused several to make forced landings in rice paddies, but the STM's held up so well that in spite of several turn-overs, none was injured.

Three of the instructors took such a liking to the Ryans that we formed a low-altitude stunt team to put on air shows to stimulate interest in the Dutch military pilot training program. They were the sweetest acrobatic planes I had ever flown.

The Ryan trainers did far more than the job for which they were originally planned, that of primary training. They were primary, basic, advanced and blind-flying trainers all wrapped up in one, and students went directly from the STM's to multi-engine equipment. The refugee Dutch pilots went to England after training in the STM's and immediately began flying twin-engine patrol planes with Dutch squadrons on the RAF Coastal Command.

You can see why I put so much faith in a Ryan plane, whether in Java for military purposes, or in Eritrea for commercial usage. In my book, the Navion is a worthy successor to those workhorse STM's.

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Don Doerr, chief photographer
William Wagner, editorial director

OPEN DOOR

(Continued from inside front cover)

rear-door ramps, or four army ambulances.

It can be loaded and unloaded in jig time. The four ambulances can be rolled out, ready for service, in 2½ minutes. Forty thousand pounds of supplies once were taken aboard in 34 minutes for the Berlin Airlift, and unloaded in 20 minutes.

It can drop 25,500 pounds of supplies and equipment by parachute in a compact area, guaranteeing virtually full recovery.

Its pressurized cabin brings the comfort of a hospital room to patients being flown to the States at high altitudes. Combat troops arrive fresh, instead of fatigued.

Now the Stratofreighter is also being equipped for use as an aerial tanker for mid-air refueling. There seems to be no end to the versatility of this gallant workhorse.

AIR FORCE PICKS TURBO-WASP J-57

One of America's most important new axial flow jet engines, the Pratt & Whitney J-57 Turbo-Wasp, has been selected by the Air Force, according to recently published reports, for installation in still-secret aircraft due for mass production.

The J-57, now being flown experimentally in a B-50 Superfortress "test bed," will be produced in such quantities that another company will be licensed soon to augment Pratt & Whitney's own capacity.

This engine's performance characteristics and fuel economy have been reported as setting new standards for turbo-jets. High fuel consumption of turbo-jet engines has been their most disadvantageous single characteristic.

Ryan has been a principal supplier of jet engine component parts to Pratt & Whitney and other engine manufacturers.

NAVION AWARD GETS NATIONAL RECOGNITION

"Flight Magazine congratulates T. Claude Ryan for establishing the Ryan Flying Businessman Award, believing it marks a milestone in the expansion of civil aviation's profound influence on the great American way of life."

This editorial comment in the April issue of one of the nation's leading aviation publications has helped draw national attention to the competition currently being sponsored to determine which of more than 2,000 Navion owners uses his plane the most for business each month.

OVER CLANCY'S SHOULDER

(Continued from page 9)

tional airplane-type control stick. Actually, he is *flying* that length of pipe. It has two control surfaces known as ruddevators; the airstream acts on them, providing the force needed to lower the boom, raise it or swing it. Guiding the thing calls for coordination and a fairish knowledge of piloting.

Binegar is running his check now. The boom swings from side to side, like an elephant's trunk. The B-50 seems to swing, too, as it climbs gradually closer. It drifts away to port, moves back in again. There's no reason for Marv Michael, the B-50 pilot, to fly a completely straight course — yet.

"Boom operator to tanker pilot — boom station is ready for refueling operation."

At this point, crew members switch their jack boxes from interphone to VHF (very high frequency radio) so everyone can sit in on the conversation between tanker and receiver.

Now, suddenly, there's plenty of reason for Michael to fly a straight course. For the receiver plane has moved up now, close to the "contact envelope."

Actually, this is no single, rigid position. Because the boom can swivel and telescope, a refueling contact can be made with a certain freedom of alignment and distance between the two airplanes. But the most desirable position for the boom nozzle, upon contact, is with the boom at a 36-degree angle and extended twelve feet. Here, in what Clancy would call the "nominal contact position," the receiver pilot has the greatest leeway of movement during refueling.

"Are you about ready to make a contact, Marv?" Binegar talking.

"Roger."

"Boom operator ready. Start moving in."

The B-50 already seems awfully close. Too close for your comfort, if you didn't remember this operation is purely routine by now. It's been done hundreds of times and by many different crews in Strategic Air Command and in air as bumpy as a Skid Road mattress.

ATOP the B-50's nose the slipway doors are already open, exposing the receptacle into which the fuel will be poured. Not poured but driven, under tremendous pressure. And with the boom Binegar is reaching for the receptacle.

"Come forward five feet, Marv. Forward four, three, two . . ."

As in any aircraft operation, there has to be coordination of the entire crew. But in this case, for a few moments' time, the two important men are Clancy and the receiver pilot.

Let's not forget the tanker pilot, though. Up front in the "97," Bob Lamson must hold the plane level, to maintain a stable platform throughout the entire operation.

Meanwhile, in spite of the speed of the plane, Binegar and Michael are still dealing in terms of adjustments as comparatively infinitesimal as one foot.

"You're overrunning a little, Marv. Back two feet. Now I'd like to find what the pilot-director lights do and what the trouble with them is."

This is not a part of the discussion in a standard refueling. It's simply a part of checking out the five lights on the tanker's underside, designed to give the receiver pilot instructions without the necessity of radio contact. Four of them light up the words "forward," "aft," "up," "down." The fifth is green and tells the pilot he's in contact position.

"Move back another foot, Marv. Did you get a green light then?"

"Right, Bert."

A pause. Then Binegar's voice again: "That's about right . . . hold it . . . good position. I'll make contact on the count of three."

Binegar counts it off as the boom reaches those last few inches. The nozzle slides along the slipway atop the B-50, settles into the receptacle."

"Contact made."

It has taken only moments, really — less time than it takes to tell. Now the pumps are surging, and gas is rushing into the thirsty tanks of the receiver plane. If you had eyes in the back of your head, you could watch the man who controls the flow of fuel—Al Perret, up forward in the tanker's control cabin. As a matter of fact, you do go up there and watch him on the next contact.

Perret is doubling as flight engineer of the tanker and pump operator. He has swung the pump panel around on its hinges so its rows of gauges are staring him in the eye.

Beside him, Bell Whitehead, flight test engineer, says, "Will you run up to maximum rpm, Al?"

Perret pulls back on the pump lever. The needle climbs on the flow-rate gauge. There's the story of the isodraulic control test, and Perret makes a circle of his thumb and forefinger.

There's more to it, of course — checking of other factors, a rapid copying of panel readings by Perret and Whitehead. Then, at length, Whitehead says, "Okay, Bert, you can initiate a disconnect now."

Binegar's voice: "Roger. I'll start the count. One . . . two . . ."

On the count of three, there's a slight bump. We're disconnected. The receiver is on its own, with a fresh load of gas.

There are still more tests that involve the tanker alone, things that can be proved out without an actual refueling, things that keep Whitehead and Perret jotting down readings. But the main show is over.

G.E. REPRESENTATIVE ASSIGNED TO RYAN

John D. Hayes, new production subcontract resident representative in the San Diego area for General Electric Co., is practically a member of the Ryan Aeronautical Company "family." A large part of his time will be spent in the Ryan factory, since Ryan is one of the principal suppliers of jet engine components for General Electric. As a matter of fact, the new $300,000 building being constructed on Ryan's 40-acre plant site, will be used to a large extent to produce G.E. jet engine parts.

MORE JUICE

(Continued from page 6)

In the "substation" was installed a General Electric transformer of 1000 KVA (kilovolt amperes) rating, and switching gear. Six large secondary distribution lines, rigid iron conduits each carrying 440 volts, were connected from the transformer and routed overhead into the sub assembly building to feed "juice" into the welding machines.

To accommodate the increased flow of electricity, the main transformer enclosure has been expanded by addition of 12,000 volt switching gear and a large outdoor oil circuit breaker as overload protection for the new underground cable and "substation."

Besides the 1000 KVA General Electric transformer, another and larger G. E. transformer, rated at 1500 KVA, has been obtained for use in any further expansion that may be required.

When production departments call for "More juice," Ryan's plant engineering department will be ready to supply it.

RYAN AERONAUTICAL COMPANY
LINDBERGH FIELD
SAN DIEGO 12, CALIFORNIA

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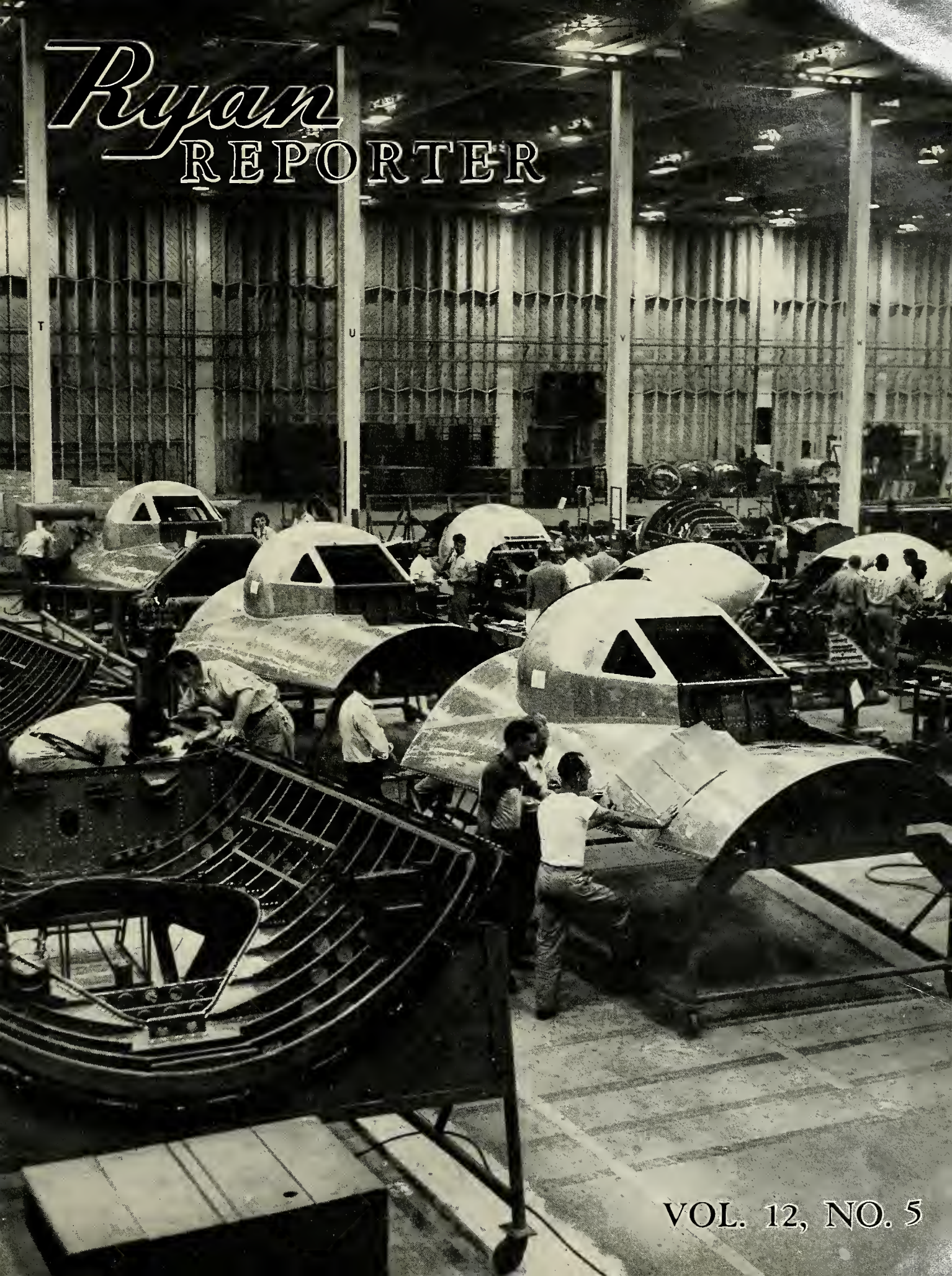
Ryan REPORTER



VOL. 12, NO. 5

Spotlight

Distribution of Ryan vendors in Los Angeles area is checked on map by General Supervisor Dempsey.

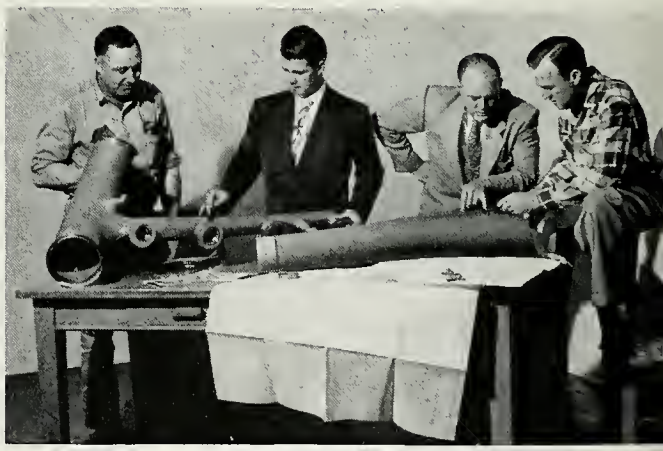
"BROADEN the defense production base."

This policy—keystone of America's expanding military might—has already resulted in gearing 60,000 subcontractors and suppliers into our aircraft production machine. More are being added to the structure every day as "outside production" specialists of the 50 major prime aircraft manufacturing firms focus their spotlights on subcontracting.

Nearly half of the dollar value of military contracts received by the prime aircraft companies is being passed along to subcontractors and suppliers.

Small machine shop or big factory . . . without the facilities and manufacturing know-how of these subcontractors, America could not achieve its amazing production records in time of crisis. Without these links, the chain of U. S. industry would be inadequate to meet the challenge it faces today.

On the seemingly endless conveyor belt of production which culminates in today's complex aircraft, a plant such as Ryan holds a key position. As an example, its long experience in the fabrication of stainless steel makes it one of the industry's key sources of jet engine components and exhaust systems. Thus, it is one of the major aircraft



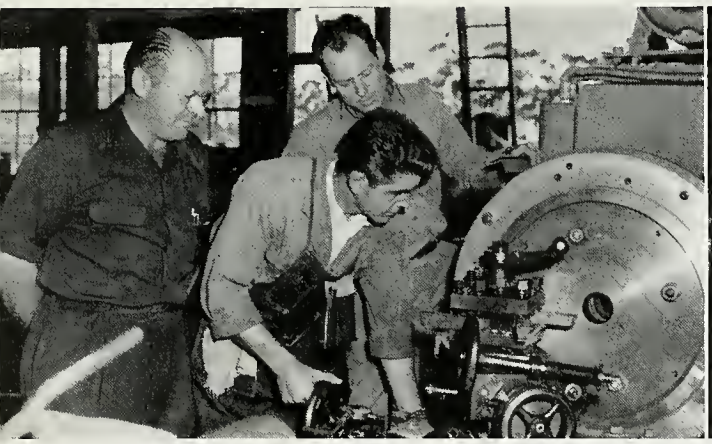
Production problem is discussed in Los Angeles by Walte Greer, who makes stampings; Carl Adams and Norman Shaw of Ryan; and Marion Glick, who does annealing and brazing

To accommodate steadily increasing number of subcontractors in the Los Angeles area, Ryan has opened o liaison office in the heart of the industrial district.

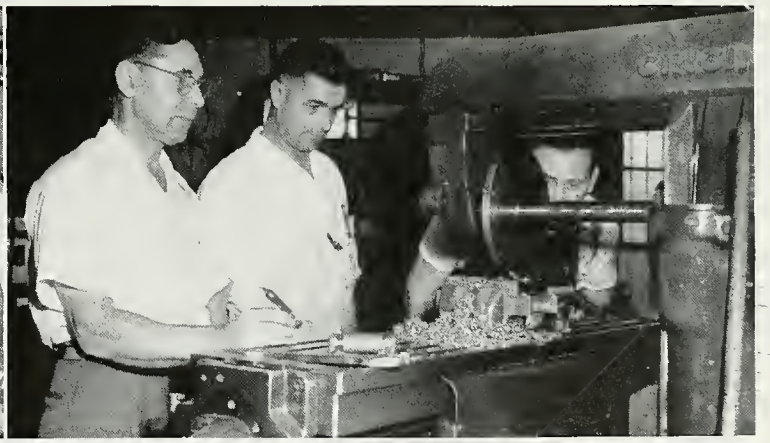
on

Typical of small subcontractors in the San Diego area is Ideal Tool & Plastic Manufacturing Co., located in building once occupied by police headquarters.

SUBCONTRACTING



ne of Ryan's "large" subcontractors, with 150 workers, is Tyce gineering Corp., Chula Vista, Cal., run by brothers Roland, at ft, and Ted, right. Jim Howard, center, operates big lathe.



Ideal Tool & Plastic also is family enterprise. Martin Lacka, left, is manager; brother-in-law, Pete Redosevich, is assistant. They are checking work of Kenneth Sansbury at milling machine.

companies depending for much of its business volume on subcontracts from other prime contractors.

At the same time, Ryan itself subcontracts out millions of dollars worth of parts to companies in California, Ohio, New York, Pennsylvania and other industrial centers.

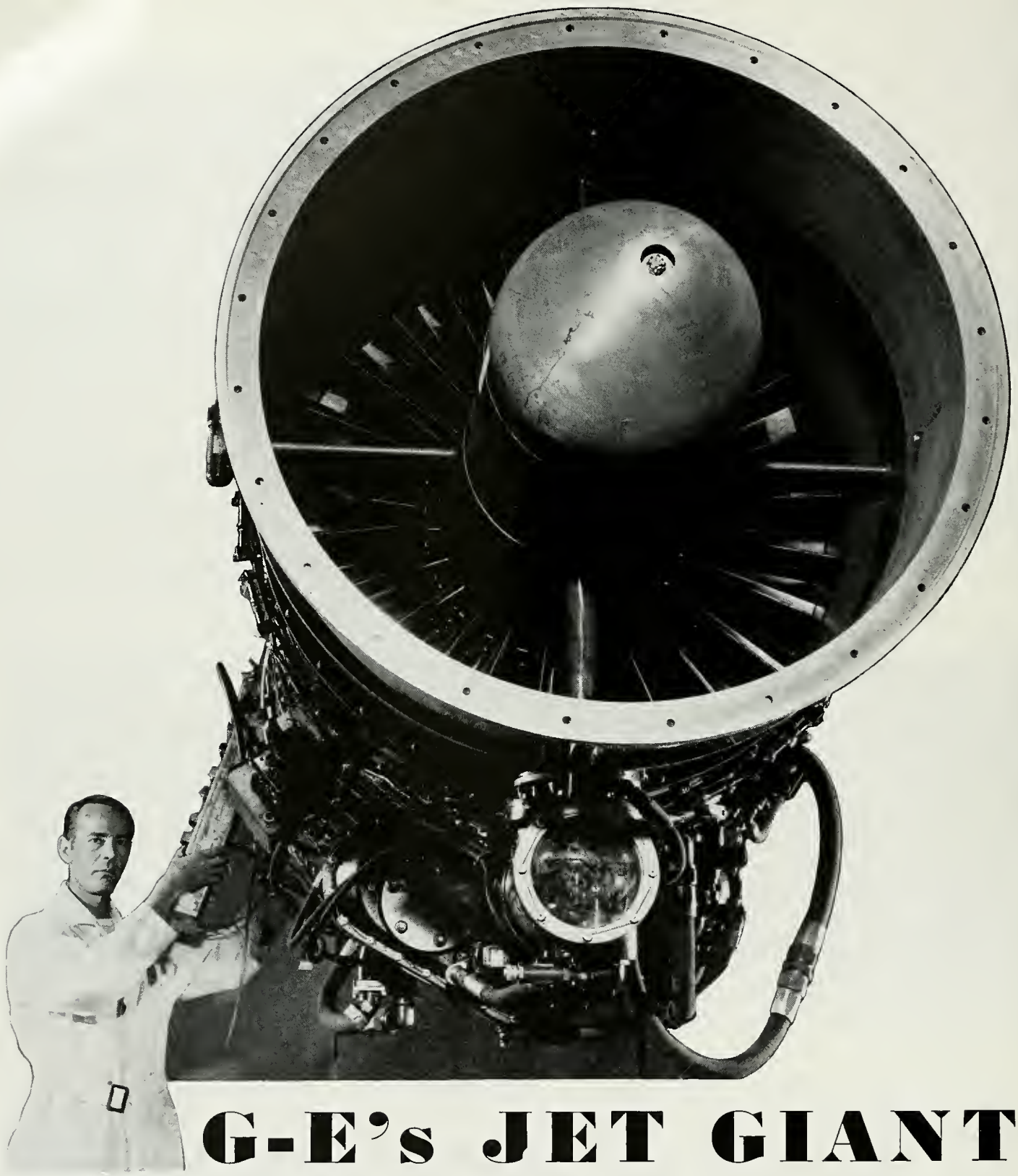
This is an ideal example of the merits of subcontracting. Because of its pioneering experience, Ryan can build stainless aircraft products more efficiently and cheaper than the prime contractor.

By the same token, a large specialized piece of work (such as the stretch forming of large aluminum sheets), or a small specialized piece of work (such as making a die for a jet engine part), can sometimes be more efficiently farmed out—i.e., subcontracted.

Virtually every prime contractor is also a subcontractor, often making specialized production machinery time available to other companies who do not have similar equipment in their own plants. For instance, Ryan Aeronautical Company, one of the nation's top subcontractors, and sole producer of the aft fuselage sections of the Boeing C-97 Stratofreighter, depends on Lockheed Aircraft Corp. for a specialized operation. Stretching of the C-97 fuselage skins is done on a forming machine worth $360,000, one of the few such production facilities in the country.

If all the factory operations involved in producing the numerous airframe components, pilotless jet planes, exhaust systems, rocket and jet components, and advanced electronics projects were to be done under one roof at Ryan, the required floor space would reach staggering proportions. In periods between defense emergencies, much of it would lie idle. Such uneconomical over-expansion is guarded against

(Continued on page 18)



G-E's JET GIANT

A new General Electric turbo jet engine far more powerful than the company's battle-tested J-47 models, but of the same frame size as the present 5200-pound thrust engines, has recently been announced by G-E Vice President C. H. Lang.

Designated the J-47-GE-21, the new turbo jet is the first of the company's "Advanced J-47" series to be announced. Many of the precision sheet metal components for General Electric engines are being built by Ryan Aeronautical Company which has been a regular supplier of such parts as exhaust cones, combustion chambers and transition liners for other models of the justly-famed J-47.

Destined for advanced military aircraft, the new engine has been described as "an important step in the world race for jet supremacy." It incorporates all the best features of the J-47 engine as proved in thousands of hours of service, plus the results of imaginative engineering supported by research and testing.

The current J-47 is the powerplant for such top Air Force planes as the North American F-86 "Sabre" fighter

(Continued on page 22)

PODS P.D.Q.

Aft fuselage fitted with first production refueling pod reaches Ryan railroad siding before midnight delivery schedule.

A PRODUCTION "miracle" is making possible large scale mid-air refueling of bomber and fighters in Uncle Sam's preparations for long-range aerial defense.

Almost six months before they would have been completed by ordinary methods, production engineering and tooling for this project have been effected at Ryan Aeronautical Company. Volume production is already under way.

Teamwork of departments within Ryan, and an unusually effective liaison between Ryan and the prime contractor, Boeing Airplane Company, were responsible for the on-schedule delivery in April of the first production unit essential to the mid-air refueling. This unit is a pod attached to the fuselage in which is stationed the crew man who communicates with pilots of both planes during the critical period of fuel transfer, when the planes are "locked" together by Boeing's "Flying Boom."

Cover photo shows assembly line of refueling pods being built by Ryan for Boeing's aerial tankers.

Urgency supercharged the atmosphere at the Boeing and Ryan plants when the Air Force decided, in 1950, to adapt its C-97 Stratofreighters into aerial "tankers" capable of refueling the high-speed bombers and fighters in mid-air, thus extending their effective combat range.

It was a rush order for Boeing engineers. Seventy-two days after they began the design, major structural changes in the fuselage had been completed, the cargo doors were replaced with the control pod to which is attached the refueling boom, and a mid-air refueling was performed.

Three prototype pods were built at Boeing from rough vellum drawings.

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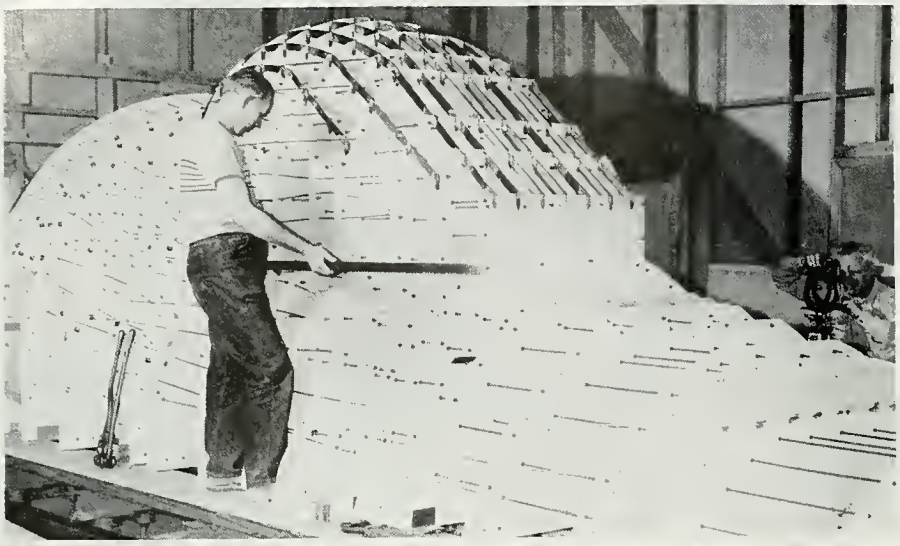
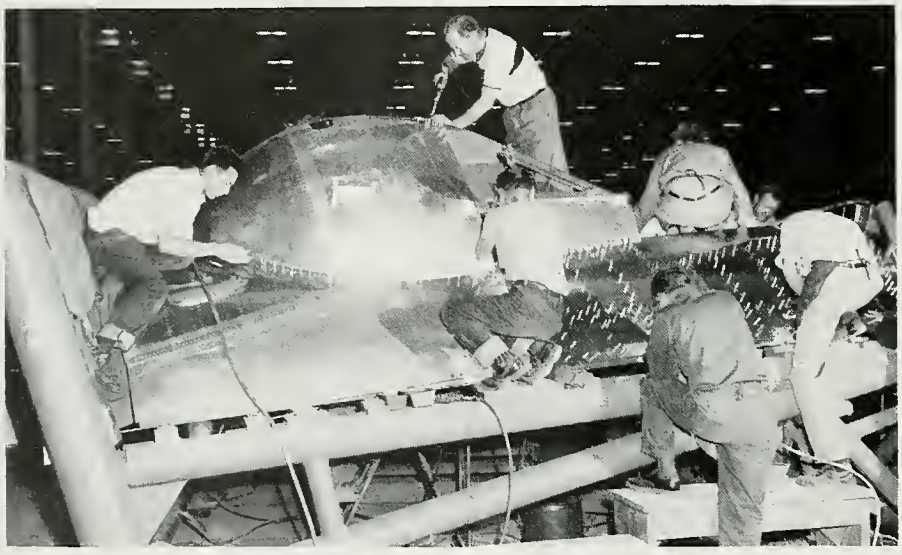


Templates are set up in modeling shop in preparation for pod's plaster "mockup."



Ryan workers install aluminum skin on first production pod as they battle time.

Boeing mechanics "quick change" C-97 transport to tanker with refueling pod.

While the first prototype was under construction. Boeing began planning full-scale production. Ryan already was deep into a large order of aft fuselage sections for the C-97, including the cargo doors. Boeing asked Ryan to produce the refueling pods to be interchangeable with the cargo doors.

Because of the job's importance, Jerry Swanson, Boeing's buying supervisor, himself came to San Diego for a conference with Robert L. Clark, assistant production manager, and Floyd Cox, production engineering superintendent. At this meeting the basic plans for tooling and production were outlined.

In September, 1950, at the start of the production drawing period, Boeing requested Ryan to send a liaison man to its plant at Renton, Washington. Paul Sommerfeld, manufacturing engineer and general supervisor of planning, made the first of numerous trips to the Northwest October 2. The following month he was joined by James Horne, tool planner. Earlier, Walter Thorpe, another tool planner, had gone to Renton for the first stages of familiarization with the structural changes required to reinforce the fuselage to support the pod and the boom.

They literally leaned over the shoulders of Boeing engineers and draftsmen to match data as fast as it was drawn and dispatch it to the San Diego plant.

It was an unusual arrangement by which tools were being built at the Ryan plant and sections of the pod constructed before anyone had a precise idea of the exact details of the entire structure.

"To get the job done when demanded by the Air Force, we couldn't wait until all the production drawings were finished," Sommerfeld explained.

"As soon as the drawing for each portion was completed, we sent it to San Diego."

For three weeks at a time, Sommerfeld and Horne worked closely with Boeing engineers, helping to develop design features that would facilitate rapid production. They would return to San Diego for brief periods to expedite solution of problems.

Two Boeing officials, William Baihly, group engineer in charge of structures, and Al Larsen, stress analyst, came to the Ryan plant for several weeks to coordinate design and manufacturing.

Sommerfeld, Horne and Boeing engineers worked together at Seattle as long as 12 hours daily. After 9 at night, the Ryan duo would still have their reports to make out in their hotel rooms. En-

Whirlwind tooling made possible completion of "pod" job on time

gineering information in bulky packages was airmailed every two or three days.

Tool orders by the hundreds were written by Sommerfeld and Horne in their Seattle hotel. Before the tooling was completed, 2,345 such orders were written—a phenomenal number for such a brief period.

Paul Sauter, general foreman of the tool room, took on the project so fast that detail tools were being made in San Diego before Ryan had 15 per cent of the total engineering information from Boeing.

In San Diego, tooling required 29,873 hours, including about 35 per cent overtime. Tool planning had required 6,420 hours, almost half of which was overtime.

"It was one of the most outstanding tooling achievements I have seen in more than 25 years in the aircraft industry," declared H. P. Rasp, Ryan factory services manager.

One of the first jobs was to get the lines drawings for construction of a plaster mockup of the pod, necessary for configuration of the skin and any formed part adjacent to the external contour.

This was to be the largest mockup ever made at Ryan and a special building was constructed to house it. John Castien, foreman in charge of the modeling shop and foundry, supervised the round-the-clock work of his crew, rushing the job.

While the mockup was still taking shape, tools for the framework were being made, an unheard of practice.

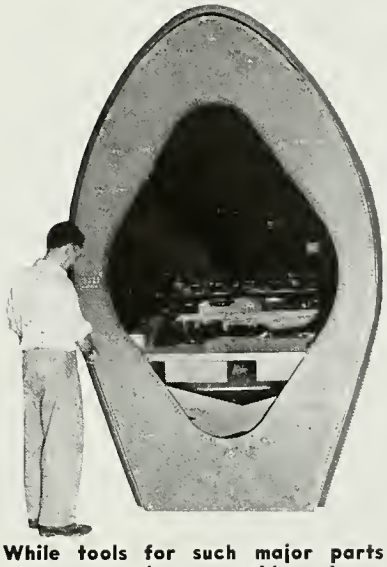
"We couldn't be sure the frames would fit the mockup in that early stage," Cox, new production engineering superintendent, recalled. "As it turned out, the fit was perfect because of close coordinations of engineering, tool planning, and fabrication."

In Renton, Sommerfeld was constantly huddling with Boeing engineers while Horne was working virtually right on the drawing boards with Boeing draftsmen. A completion date of April 10 was set for the first production pod at Ryan.

WORK in the San Diego plant raced into high gear. More men were assigned to the complex tooling job. A skilled team, pulling the most out of each hour to meet the April 10 deadline, often worked 65 to 70 hours a week, Saturdays and Sundays included, to get the job done.

At one time, there were as many as seven tool planners, four tool designers, 30 jig and fixture builders, and 10 plaster pattern makers in the feverish contest against time.

"On December 14, when the April 10 deadline was set, it seemed impossible to meet, with the tremendous amount of detailed work still to be done," Cox said.



While tools for such major parts as crease ring assembly, above, were being made, construction of smaller sub-assemblies continued.

Refueling boom operator in Boeing KC-97 Stratafreighter is shown at his controls in refueling pod. He gets panorama view of operation through 3 large windows.

"But the spirit of the men was high and they met the challenge."

To which Bob Clark, assistant production manager, adds this observation:

"I've never seen such wonderful morale among a group of workers in my life. The cooperation within and between departments was excellent."

"If not for the top speed performance of the workers on the floor—in the tooling, production and inspection departments—we never would have been able to assemble this pod in record time."

Joerg Litell, executive assistant to John van der Linde, production manager,

(Continued on page 23)

Paul Sommerfeld of Ryan made many trips to Boeing for engineering consultations.

Liquid stainless steel flows like fluorescent water from this giant electric furnace at Republic's steel plant in Chicago. A 70-ton batch of carefully selected ingredients is handled in each fiery melt.

Hot stainless steel strip rolls through Repu

Republic tailo

Ryan jet pa

STERLIN

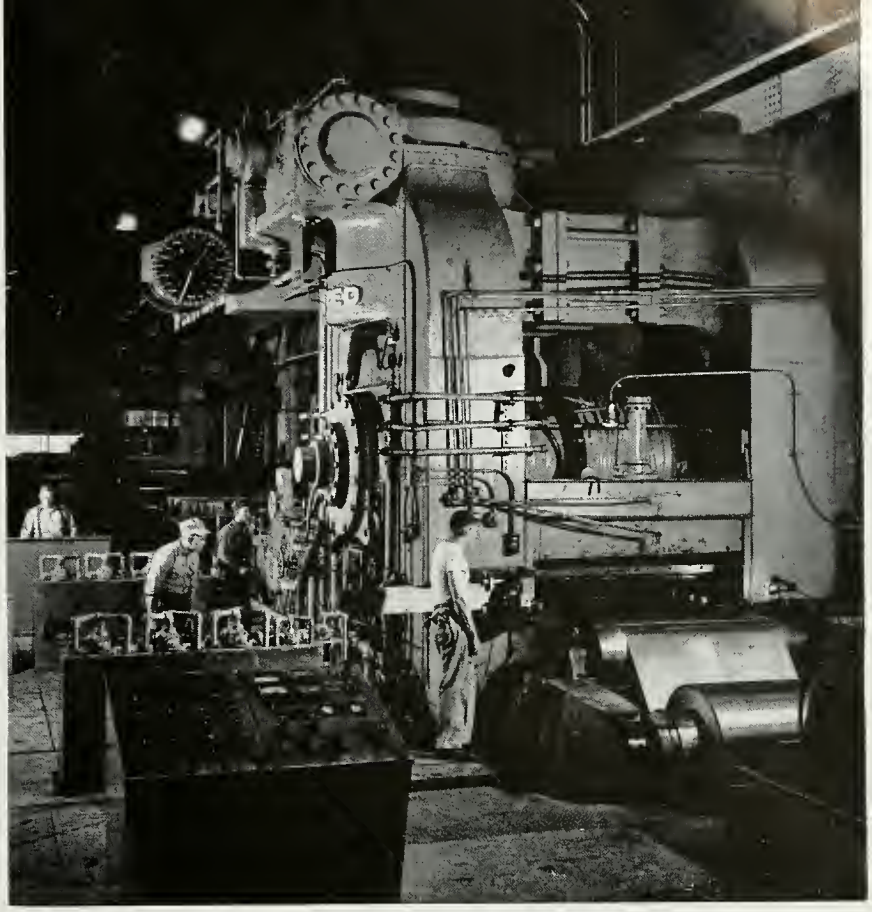
SO much stainlesss steel is used at Ryan —nearly ten carloads a month—that those who work with it have come to regard stainless steel as a commonplace raw material. Familiarity with the gleaming sheets of white metal have obscured the realization that stainless steel is the "precious metal" of the steel industry and that, although considered a raw material by Ryan, it is the finished product of a billion dollar industry.

Over a period of years Ryan has become the outstanding producer of aircraft exhaust systems and jet engine heat-resistant components — made exclusively from stainless steel and corrosion-resistant alloys. It requires a sizable portion of the stainless steel production of half a dozen major steel mills to feed this flow of production at Ryan. An important producer of these modern rustless alloys for aircraft use is Republic Steel Corporation whose plant at Massillon, Ohio, can turn out 12,000 tons of strip stainless steel a month.

Republic supplies Ryan with substantial quantities of type 19-9DL, 347, 321, 310 and 410 alloys. These are transformed into exhaust cones, combustion chambers,

Precious cargo from Republic is this shipment of stainless steel sheets being unloaded at the Ryan Aeronautical Co. plant in San Diego.

98-inch, 6-stand mill in Cleveland, Ohio.

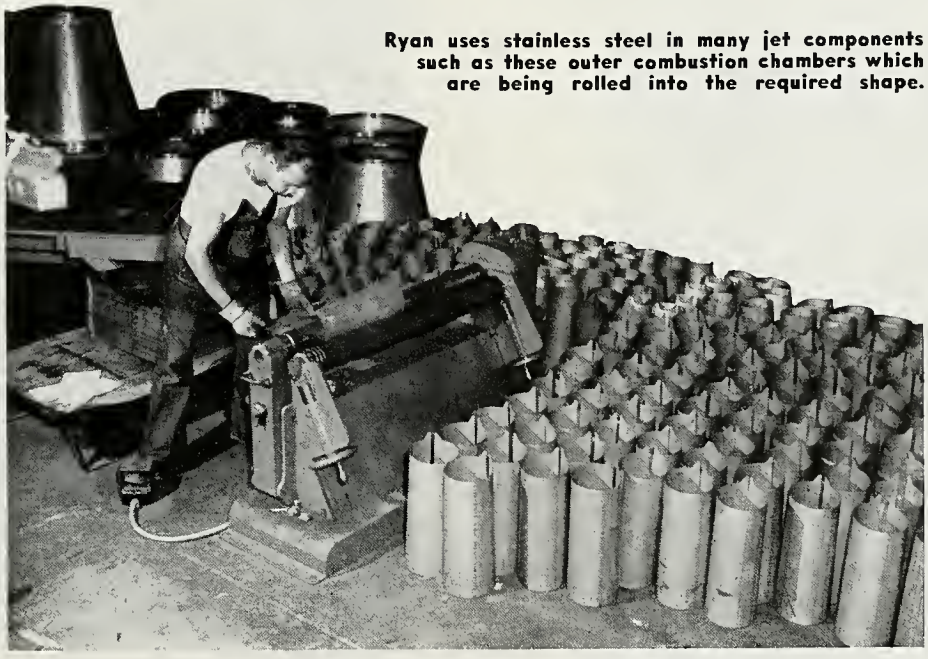


A massive stainless steel rolling mill at Republic's Massilon plant. Driven by a 2,000 h.p. electric motor, this powerful machine can exert pressures up to 5,000,000 pounds to produce gauges suitable for Ryan.

ainless steel for

nd exhaust systems

G STEEL



Ryan uses stainless steel in many jet components such as these outer combustion chambers which are being rolled into the required shape.

transition liners, tailpipes and other components for powerful gas turbine power plants, and exhaust systems for high horsepower piston engines. Ryan-built components must perform at constantly elevated temperatures ranging up to 1800°F. In this volcanic environment steels with tensile strengths of 100,000 pounds per square inch decline to less than 15,000 p. s. i. and corrosion and scaling are greatly accelerated.

The unusual requirements for steels for aircraft use have made it necessary that metallurgists from Ryan and the mills who supply the company's extensive requirements work together in close association. This has had many mutually beneficial results. The technical studies and reports of Wilson Hubbell, Ryan's chief metallurgist, for example, have been influential in the general switch from stainless steel of 18-8 nickel-chromium ratio to one with an 18-10 proportion. Hubbell's data indicated that 18-10 stainless would be better for forming because the work hardening of the alloy is largely a function of the nickel-chromium content, other factors being constant.

Republic's extensive metallurgical in-

(Continued on page 25)

Extrusions and formed sections are part of shelf stock for airframe assemblies.

STOCK in TRADE

Two million pounds of materials move monthly through Ryan's "Big Store"

"STORES" for production operations in the expanding Ryan plant is an efficient combination of more than a dozen receiving, storage and issuing stations, staffed by a hundred specially trained men and women. Two million pounds of materials and machinery are handled per month in the overall operation.

Largest single concentration of materials is in the 50x300 foot Raw Stores building where new materials continually flow into the big stockroom from Receiving Inspection. Too, throughout each shift a corps of dispatchers and transportation men arrive in the building's "make-up area" with requisitions for materials required by every production department.

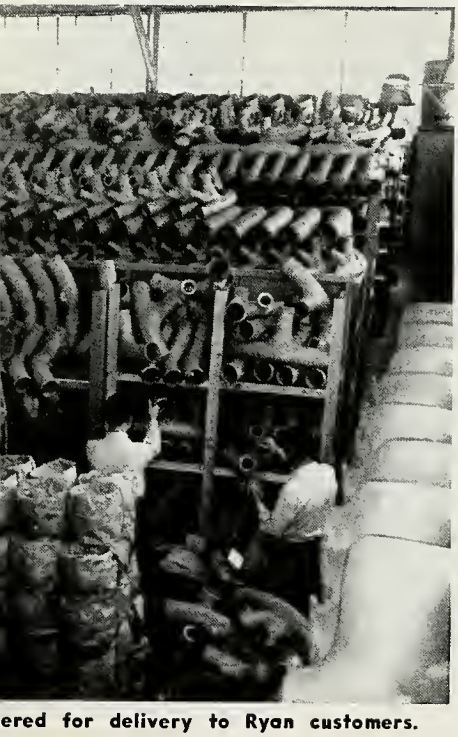
Supervisor E. J. Draper assigns the filling of requisitions to his experienced staff who quickly locate the stock asked for and issue desired quantities. This usually requires the use of templates that have been prepared for items ranging in size from small parts to large "skin" sections. Laid on the surface of the appropriate aluminum, steel or magnesium sheet, a template permits "nesting" and marking off an outline for accurate, economical cutting.

Draper calls his men "cut-off conscious," meaning they take pains to sup-

(Continued on page 20)

In Shipping Accumulation manifold parts

Strong enough to bear a 6,000-lb. load, a six-armed "sheet lifter" moves aluminum sheet in 15,000-sq. ft. Raw Stores building.



ered for delivery to Ryan customers.

Mechanized lifting devices are used to handle the heavy press dies in new and enlarged tool stores.

Charles F. Hoover's promotional Navion, sporting 250 ft. of neon tubing on its wings, is painted distinctive Dial Soap colors.

FLYING SIGN BOARD

"FOR a rugged individualist and a good plane nothing is too big to accomplish," friends said back in '46 when Charles F. "Chuck" Hoover, young Valparaiso, Indiana, advertising man and ex-Air Force pilot, bought the first Navion delivered in Indiana.

Later in 1949, after a couple of years experience as a charter operator, Hoover was set to prove how right they were as he invested all his time, ingenuity and hard cash in a sky-high idea for product promotion.

For months he worked to attach 400 pounds of neon tubes, loud speaker, wires and radio equipment to his Navion. Then he succeeded in convincing Armour & Company that a "flying billboard" would most quickly acquaint the nation with their new Dial Soap.

Starting in Kansas and moving north to Minnesota, east through New England, south to Florida and across to California, he covered the country, his 250 feet of neon tubes flashing "Dial Soap Stops Odors" while his loud speaker played the inoffensive Emperor Waltz.

In a year's time he calculated he would fly 500 hours just at night alone. In one 360-degree turn over Chicago he saw his message reach 175,000 people gathered at Soldiers Field, the Chicago Fair and the White Sox Ball Park.

His lovely wife, Lois, and daughter, Jackie, round out a flying family for this resourceful Indiana pilot.

Besides the impression left with millions of viewers on his tour, his project and plane were subjects for 47 radio shows, 10 telecasts and 44 newspaper and magazine articles.

By the end of eight months, he was ready for a rest. While doing a crack job of selling Dial, he had given the country a dramatic example of the versatility and dependability so generously incorporated in a modern executive plane like the Navion.

Pleased with the results of this first tour, Armour has renewed his contract on an even larger scale for 1951-52. After a brief time with his wife, Lois, and 5-year old daughter, Jackie, Hoover and his Navion will be ready again to "Dial" the 60,000,000 Americans who will look up when they hear music in the air.

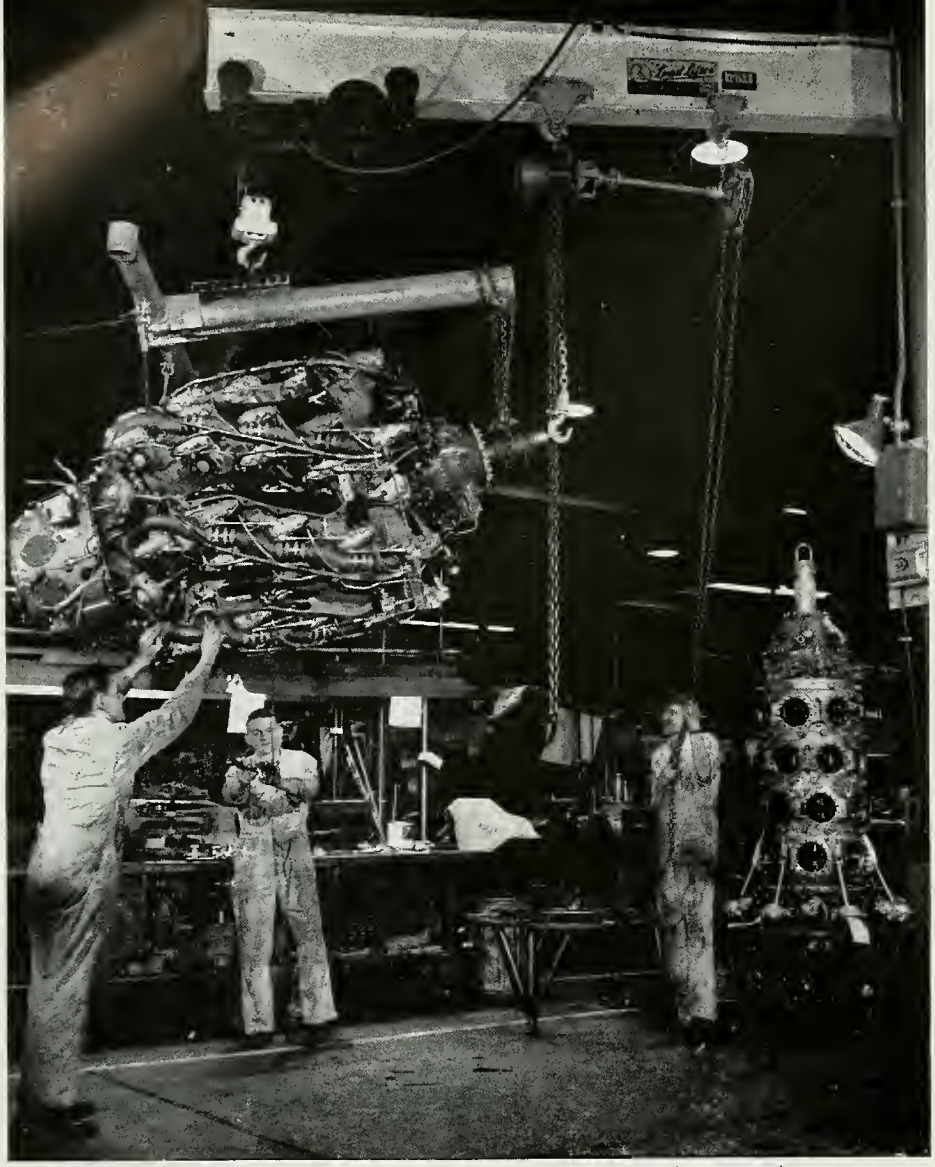
Double-decker

FOR a mere two-year-old, Boeing Airplane Company's 72-ton "baby", the commercial airline Stratocruiser, has developed tremendously since Pan American World Airways' first "377" went into service April 1, 1949.

Fifty-seven double-deck airliners, operated by United Air Lines, Northwest Airlines, Pan American, British Overseas Airways Corp. and the U. S. Military Air Transport Service have carried more than 750,000 passengers approximately 45,000,000 miles since the first one entered commercial service from San Francisco for Honolulu.

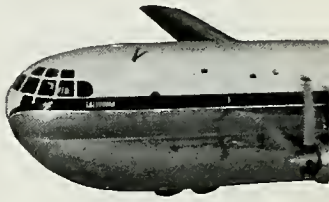
Northwest was second, in the late summer of 1949, to send the huge

(Continued on page 12)



Northwest Airlines mechanics using heavy duty crane, hoist Boeing Stratocruiser engine, weighing 6,000 pounds, preparatory to setting it on engine overhaul stand in their St. Paul, Minnesota, workshop.

ships on their way, with a Chicago-Twin Cities run. American Overseas Airlines, since purchased by Pan American, joined the parade August 17 with a Stratocruiser on its New York-London route, and British Overseas made its first London-New York Stratocruiser flight December 6 that year. United completed the list when on January 15, 1950, it sent a double-decker on its way from San Francisco to Hawaii.

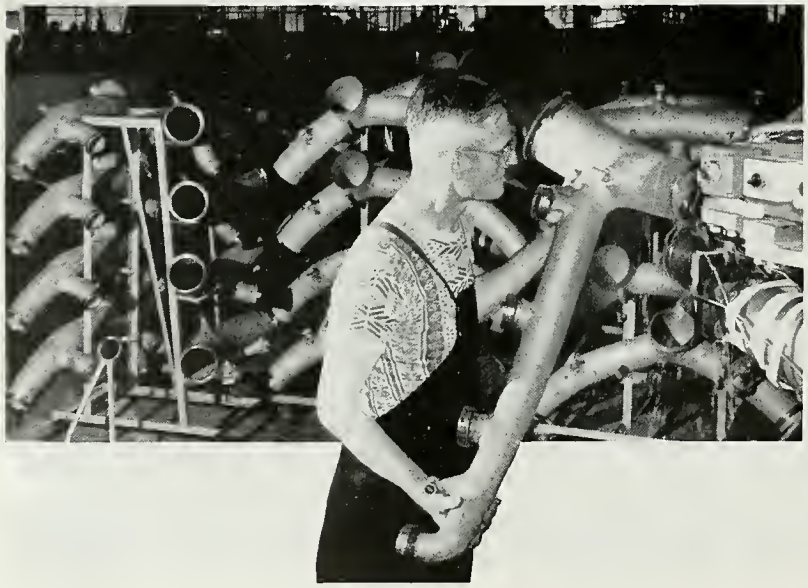


"Vital statistics" of the Stratocruiser give some indication of the tremendous power used in speeding its 142,500-pound gross weight at cruising speeds up to 340 miles an hour and range over 4000 miles. Pressurized for operations up to 30,000 feet, the "377" carries nearly 8000 gallons of fuel weighing 24 tons.

Fourteen thousand horsepower is supplied by the four Pratt and Whitney Wasp Major engines, each developing 3500 horsepower for take-off. To handle the searing gases generated by each of the 28 cylinders in the giant four-row

(Continued on page 24)

Exhaust system part for Pratt & Whitney R-4360 Wasp Major engine, such as used in the Boeing 377 Stratocruiser, is seamwelded by C. S. Renner at the Ryan Aeronautical Company plant in San Diego, Calif.



Slip joints between header sections, which must be kept free of ceramic coating where parts are slipped together, are "masked" with clay solution by workers at California Metal Enameling Company.

Progress Report on CERAMICS

"Ceramics for the hot spots" becomes an established principle on some of the largest airliners

THE ceramics idea has taken firm root and is flourishing in the aircraft industry.

Pioneered by Ryan Aeronautical Company and proved in extensive tests under the most rigorous field conditions, the use of ceramic coatings for exhaust systems is rapidly becoming standard practice on some of the nation's largest airliners.

The first service tests of ceramic coatings to improve heat resistance qualities and check erosion at the hottest spots of an exhaust system were performed in a Pan-American World Airways' Boeing 377 Stratocruiser assigned to trans-Pacific operations. Pan-American assigned a plane from this run for the tests because of the long distances traveled and the consequent rapid accumulation of flight hours on the Pratt and Whitney R-4360 Wasp Major engines.

In this plane, only the header sections of the exhaust systems were coated — some only on the inside, and some inside and out.

After more than 1800 hours service, close examination has shown such protective qualities that Boeing has decided to equip the entire fleet of Stratocruisers with ceramic-coated header sections as replacements are made. These giant transports are flying for Northwest Airlines, British Overseas Airways Corporation, United Air Lines and the Military Air Transport Service, as well as Pan-American.

In addition, as uncoated header assemblies are removed from the Stratocruisers for routine maintenance, they are being sent to Ryan for the incorporation of ceramic coating and are then returned to the airlines for reinstallation. Meanwhile, a close check is made by C. L. Foushee, Jr., Ryan service manager, whenever an engine already equipped with ceramic-coated headers is changed for overhaul.

To obtain further experience with ceramic coatings, a complete collector ring assembly and header assemblies were coated both interior and exterior and installed on a Pan-American World Airways System airplane at San Francisco for

(Continued on page 22)

Ceramic-coated exhaust system parts are inspected by C. L. Freeman as they are received from enameling company. Ceramics use is becoming standard practice.

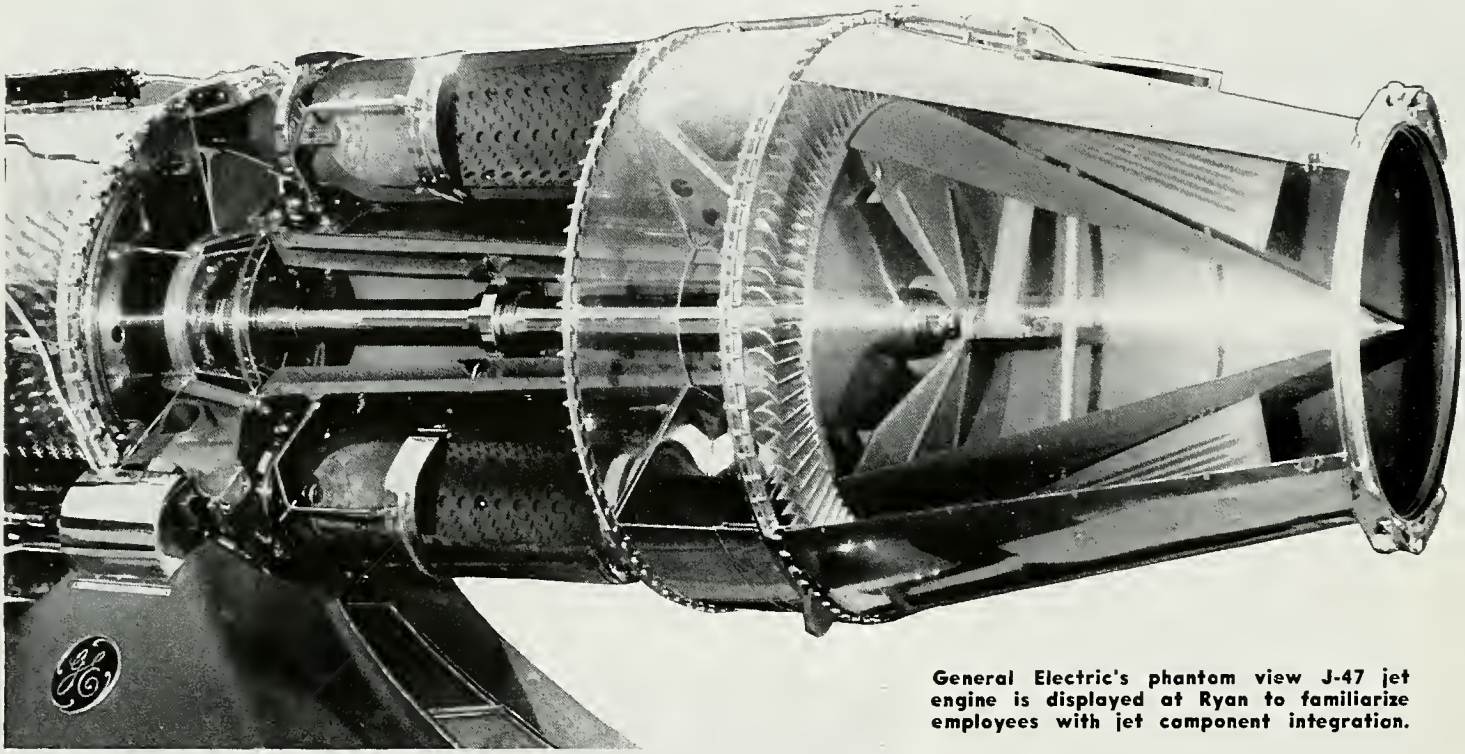
THE jet engine is causing inspectors to split hairs—and gray hairs at that. They are squinting at analyzers, comparators, gauge blocks and other precision measuring devices with an intensity never before required. The jet engine and its extremely close tolerances is making a laboratory technician out of the inspector.

This new standard of precision has been brought about by the almost universal conversion of military planes to gas turbine power plants and the accelerated production requirements which the rearmament program demands. This is translated into thousands of new jet engines, each with many high temperature, precision-made components to handle the fiery thrusting gases of these power plants.

Ryan is building large quantities of these vital components for the major jet engine manufacturers. An inspection program to establish and maintain quality control has been developed by the manufacturing inspection department to insure the high precision which must be built into these parts.

Take the General Electric J-47 turbojet, for instance. Ryan fabricates complete exhaust cone assemblies, transition liners, combustion chambers and tailpipes for this thrust mechanism which can develop an equivalent of 10,000 horsepower. Breathing 3 tons of air a minute, this engine could empty a six-room house in 7 seconds. Internal temperatures of 2000°F. and air speeding through the engine at 1200 miles per hour must be safely handled by the metal components made by Ryan.

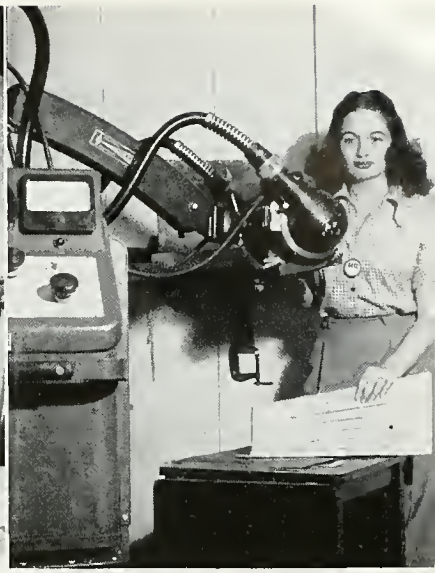
Tolerances required for these parts are extremely close—especially in view of the



General Electric's phantom view J-47 jet engine is displayed at Ryan to familiarize employees with jet component integration.

PERFECTION in JET INSPECTION

With the Brush Surface Analyzer, Jim Turner can "feel" variations of a few millionths of an inch.



Left: Charles Brown, Ryan tooling inspector, gauges tail pipes for B-47 bomber. J-47 combustion chambers in foreground. Right: Weld seam in jet engine strut is "scrutinized" by X-ray equipment under supervision of June Underwood, technician.

fact that most of these units are a combination of sheet metal alloys and precision-machined members. Yet these exacting tolerances must be met—and are being met in everyday production—to guarantee the performance which engineers have designed in the J-47.

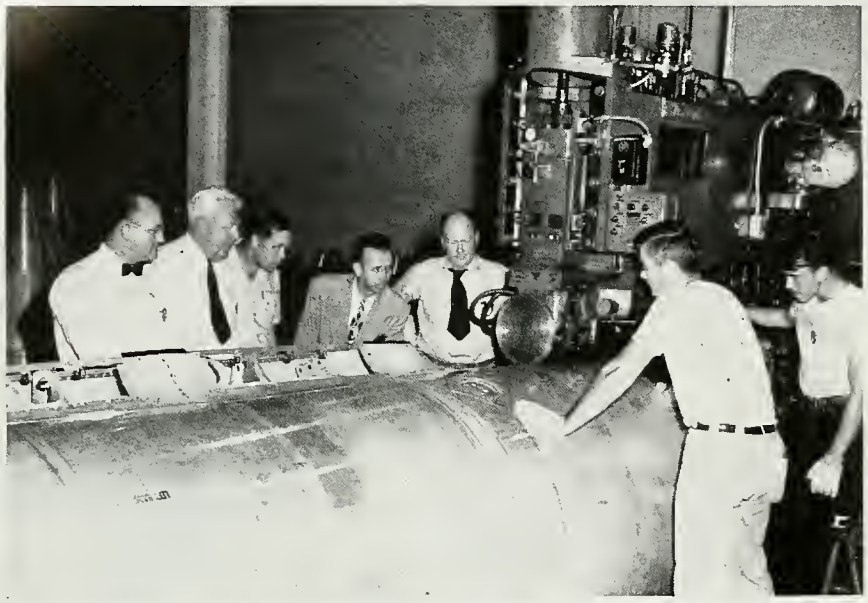
No less authority than Air Commodore F. R. Banks, Director General of British engine production and development during the war years, has recently stated, in essence, that the nation which can produce jet components most rapidly and economically in terms of man hours will dominate in air rearmament. In a story published by "The Aeroplane," leading British aviation journal, Commodore Banks states, "Americans excel in this high class sheet metal work. In fact the term 'precision' can well be applied to American methods of fabricating sheet metal parts which are made to almost machining accuracy."

To obtain this sort of accuracy in manufacture, Ryan has organized teams of inspectors which are especially trained in the high requirements outlined by the engine manufacturers. They scrutinize every sheet of metal, casting, forging and

(Continued on page 16)

Jet parts are magnified 100 times by Comparator which John Kenny is using for visual examination.

Left: Robert Chase of production manager staff, and Luis Emilio, leadman, inspect a newly-fabricated jet engine component. Right: Ryan jet engine component is given a hardness test by Dorothy Bauman, inspector, using the Rockwell testing machine.



American Stove Co. and Ryan officials study roll seam welding of huge fuel tank section. Left to right are H. P. Rasp and Sam Breder of Ryan; Raymond Johnson and Victor Frank of American Stove; and R. G. Wells, Ryan resistance welding foreman.

Contract For Consulting Service

To help speed production of urgently needed external fuel tanks of Ryan Aeronautical Company's own design, the company has begun entering into assistance contracts with other manufacturers which will serve as alternate sources. First such contract is with American Stove Company which will soon begin production of the huge fuel tanks at its St. Louis, Missouri, plant.

So that increasing military requirements for the Ryan external tanks, largest known to be in production, may be met, it has become necessary for the prime airframe manufacturer to establish several sources of supply. As an aid to the expanded program, Ryan has offered to educate the alternate manufacturers in the advanced production methods the company has developed.

Such extensive use is being made of resistance welding in building the tanks that Ryan is now one of the best equipped plants in the world for this specialized work. Many other welding machines are on order.

As part of the assistance contract, American Stove recently sent Victor Frank, fuel tank project engineer, and Raymond Johnson, tooling engineer, to the Ryan plant for an extended study of manufacturing techniques.

PERFECTION IN JET INSPECTION

(Continued from page 15)

assembly in each stage of fabrication. An increasingly greater amount of production time is now allotted to the inspection processes, as the work progresses through forming, welding and machining.

A jet assembly, such as the exhaust cone for the J-47, is carefully inspected while it is in each machine tool, both before and after machining. This inspector locates all horizontal, vertical and angular measurements before the machine operator performs his boring, drilling and other machining. After the machine work, the inspector again makes a careful check of the location of all work done because the close tolerances make it difficult to locate the work in the exact position in the machine tool after it is once removed. In this way, inspection supervises the critical machining of the parts—thus relieving the machine operator of some of this heavy responsibility.

Often a trained inspector is sent by Ryan to other cities to inspect a jet assembly which a vendor has set up in a machine tool. It is simpler to do this than to risk the removal of the part from the machine before complete inspections are made. The hole patterns on these assemblies must be accurate within .005" and some holes are located within .003".

Large finished flanges and rings for the J-47 turbo-jet and its latest D-17 model are finished to a smoothness of 63 micro finish. Variations in surface finish of more than 63 millionths of an inch will not be acceptable. To check these finishes, Ryan inspectors use finish gauge blocks and surface analyzers which "feel" the microscopic "peaks" and "valleys" in metal topography.

A typically precise part is the bolt gland and body which sprays fuel into the afterburner of jet engines. This assembly consists of two machined parts which are threaded together in a metal-to-metal contact which must withstand a hydraulic pressure test of 600 pounds per square inch. Surfaces of these small units are required to have a 63 microfinish and the threads are checked in a comparator which magnifies them 100 times to check thread contours.

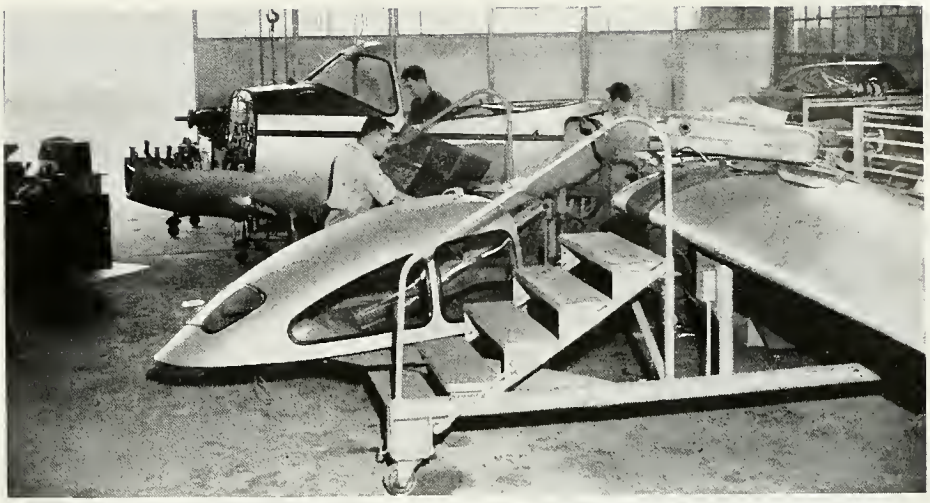
BECAUSE a jet engine assembly is an elongated affair made up of circular sections attached one after the other, great care must be taken to see that each individually-made section is fitted to the next in true proportion. Otherwise, the whole assembly may be unacceptable even though each unit is accurately made. To check this build-up of units, Ryan inspectors constantly gauge the relationship of one surface to another reference point, with Johansen-type gauge blocks. These blocks are accurate to 4 millionths of an inch in length. They are so smooth that two of them with just one-half square inch of contacting surface, will resist a force of 200 pounds tending to pull them apart.

The blocks are used to measure assemblies by comparison. A block is set against one surface and a gauge is then used to determine the difference in length between the block and the other surface. In this way dimensions of as little as .0001" can be determined.

Because many of the new jet assemblies represent an investment in materials, machining and forming of as much as $3000 a unit by the time they reach final inspection, the responsibilities of the inspectors increase as parts progress through the factory. Engine manufacturer's blueprints and instructions indicate the exact maximum and minimum measurements permitted for each part, and no deviation is allowed. This is in distinct contrast to the former methods of delineating the job where single measurements are quoted and ordinary shop practices permit reasonable variations from these figures. Now, everything is rejected if it isn't within the blueprint tolerances.

These modern manufacturing specifications have emphasized the importance of the inspector and have shifted to his shoulders a responsibility which is almost laboratory-like in nature. Only in this way can the enormous numbers of gas turbine assemblies be manufactured to precision measurement with the present supply of production machinery and available labor.

UP-DATED NAVIONS



Each Navion is disassembled at the start of the modernization job. Work is done by mechanics and technicians with four years of experience in servicing Navions.

TO take one of North American Aviation's Navions off the shuttle run between Los Angeles and Edwards Air Force Base at Muroc, California, for several weeks would ordinarily draw a lot of argument from Engineering Flight Test Supervisor Mel Beach, who is in charge of the planes. But not so in the case of the month-long modernization job currently scheduled for each ship in Ryan shops at San Diego, a project close to Beach's heart.

Each of these six planes—originally built by North American—is a veteran of some 2,500 hours of heavy usage by the engineers and technicians who divide their time between the North American factory and the Edwards testing grounds beyond the 8,000-foot San Gabriel Mountain Range, as well as flying frequent shuttle service between the various North American plants.

One by one—in order not to disrupt the eight round-trips-per-day schedule to Muroc—the planes are flown to the Ryan Navion Service Department for expert modification designed to bring them up to standards of the 1951 Navion.

As it reaches the Ryan plant, each ship is completely disassembled, and given a thorough detail inspection. Engines are replaced with Continental remanufactured 205 h.p. engines, and metal blade Hartzell propellers are installed to provide increased performance. Fuel tanks and plumbing, and hydraulic selector valves, cylinders, and lines, are replaced with the latest types. Control cables, bushings and other parts subject to wear are replaced as necessary.

Controllable engine cowl flaps are in-

(Continued on Page 21)

Pilots John Typer and Charles Graham and Flight Supervisor Mel Beach with one of North American's Super 260's.

Ryan renovation for North American's six 2,500 hour veterans

Looking "like new," modernized NAA Navion receives final inspection from Ryan service supervisors Walter Balch and Bob Stone.

SPOTLIGHT ON SUBCONTRACTING

(Continued from page 1)

by the use of subcontractors.

Thus, not only are the peak emergency production demands met, but the small businessman who otherwise would suffer through a curtailment of consumer goods production is maintained as a dynamic force in the nation's economy.

"Problems of floor space and labor supply are overcome through distribution of certain types of work among subcontractors who are especially qualified to perform these jobs," explains Rex Dempsey, Ryan supervisor of outside production, who has had many years' experience in outside purchasing.

"Ryan thus has more space to concentrate on production of larger assemblies. Small sub assemblies converge in the plant from subcontractor and enter the assembly line.

"Subcontractors are so essential to our operations that some departments would be seriously crippled without such outside production. In a recent period of less than one year, we had 236,000 manhours of work performed by our subcontractors, and this amount will be doubled by the end of this year, based on present schedules."

Ryan depends on subcontractors for specialized welding, sheet metal work, machined parts, hydraulic and mechanical assemblies, spinnings and ceramic coatings for "hot spots" in exhaust systems.

Of Ryan's 135 principal subcontractors, Los Angeles County, well established as the "Pittsburgh of the West," is the location of 73. So important has that area become as a source of supply that Ryan has opened an office in the hub of its industrial district to serve as liaison between the plant and vendors. Carl Adams, formerly liaison man for outside production, is in charge of the office, which provides direct teletype service with San Diego headquarters. Quality control, one of the major problems in subcontracting, is maintained through a corps of inspectors under Steve Orban, who consult regularly with the vendors.

Can anyone with mechanical skill become a subcontractor? Those who venture into this field learn that the qualifications are rigid. They must have more than manufacturing know-how, which of course is the prime requirement. They must have adequate plant facilities, suitable machinery and tooling, a sufficient labor force, and financial responsibility. Without these assets, a subcontractor could become a pain in the bottleneck to his customer.

Ryan is constantly on the lookout for reliable new sources. Prospective subcontractors are urged to send brochures outlining their equipment, experience and production record in World War II. An acceptable Dun & Bradstreet rating is highly desirable, but limited operating capital does not necessarily defeat a subcontractor otherwise fully qualified. A big prime contractor like Ryan may decide to provide the raw material, for instance, closely supervising its fabrication, according to M. K. Smith, chief of materiel.

BUYERS who are experts in their fields — shch as welding, sheet metal, mechanical parts, etc. — make an on-the-spot check of the potential subcontractor's facilities and labor situation. If acceptable, an order is negotiated, and close liaison is maintained by the outside production department with the subcontractor to assure his fulfilling schedules on time and meeting inspection standards.

Buyers from the outside production department are in the field constantly, tackling the tough job of locating subcontractors able to produce satisfactorily and to deliver the material when expected.

Subcontracting help may come from unusual sources. Roy Haglund, a Ryan outside production buyer, discovered a

(Continued on page 19)

JET PARTS BUILDING WORK RUSHED TO SPEED NEW ORDERS

New orders for $8,000,000 for jet engine components recently received by Ryan Aeronautical Company have emphasized the value of the additional production facilities which will be provided by the new jet parts factory building, above, now being rushed to early fall completion.

Costing in excess of $300,000, the new 250-by-300 foot building will be equipped with $2,000,000 worth of specialized jet engine components production machinery including extensive resistance welding equipment.

The new orders Ryan has received are from General Electric Company and Wright Aeronautical Corp. and bring the company's backlog of unfilled orders to over 40 million dollars.

Already in large scale production of many components for the "hot end" of General Electric J-47 jet engines, Ryan will further increase its delivery of exhaust cones, combustion chambers, exhaust nozzles, transition liners, aft frames and other parts for latest models of the J-47 engine.

For Wright Aeronautical Corp., Ryan is scheduled to go into volume production of exhaust cones for the 7200-pound-thrust J-65, Americanized version of the famous Armstrong Siddeley Sapphire jet engine, originally developed in England.

Wright Aeronautical, newest piston-engine manufacturer to enter the jet field, is undertaking one of the greatest subcontracting programs in the country today to put the powerful J-65 into mass production. Some of Ryan's top technical people and customer service representatives have been working closely with Wright at its Wood-Ridge, N. J. plant in connection with the conversion of the English Sapphire engine to American production standards.

small shop where most of the work is done by paraplegics, men and women whose legs are paralyzed but whose hands are nimble. He found the operation ideal for subcontracting out the assembly of electric harnesses and hand de-burring of stainless steel punch press parts.

Whenever a part is rejected at receiving inspection in the Ryan plant, a copy of the rejection report is dispatched to the vendor for immediate correction of the trouble in future production. Tooling experts, engineers, inspectors and outside vendor contact men are available at all times to help reduce the amount of rejected parts and enhance the quality of the finished product. When difficulty is met in procurement of materials, Ryan uses its priorities to obtain them for the subcontractor.

In the aggregate, subcontracting is big business, but nine out of ten subcontractors are small businessmen. The Defense Department classes a business as "small" when it has less than 500 employees. Most of the subcontractors with whom Ryan deals have considerably less than that number and are essentially family enterprises.

A "large" subcontractor in San Diego County, for instance, is the Tyce Engineering Corp., Chula Vista. Roland Tyce is president and general manager, his brother Ted is vice president and shop superintendent; and Roland's wife, Muriel, is secretary and treasurer.

Early in the 1920's, Roland and his father had started a company to make composition stucco and flooring. These facilities in Chula Vista were converted in 1943 to production of thousands of units of a specialized tool, a tilting arc.

When World War II ended, the forward-looking Tyces expanded while most everyone else in defense work was dashing for economic storm-cellars. They acquired large quantities of war-surplus machinery at 25 percent of the present cost. They stocked up on equipment that would give them a complete operation, from turret lathes to thread grinders and heat treatment facilities. "Everyone thought we were crazy, but it's paying off now," says Roland Tyce.

Between World War II and the Korean conflict, the company struggled along, making small model plane engines hydraulic sleeve-pulling tools for V-8 engines, and key-cutting machines. When aircraft production began to perk up, Tyce was ready. The payroll started to climb, the stockpile of surplus machinery went to work, and the payroll climbed to its present 150. Today Tyce supplies vitally needed detail parts for Ryan. From as far away as Indianapolis, other large companies are relying on Tyce.

ONE of Ryan's dependable subcontractors is the Ideal Tool and Plastic Manufacturing Company, whose 25 employees work in an old two-story building in downtown San Diego, once occupied by the police headquarters and courtroom. This is a family partnership which transplanted its business from Detroit.

Martin Lacko, the manager ("which means anything from sweeping the floor"), has been a tool and die maker for 35 years. When his wife's health required a change in climate in 1943, the family moved to San Diego, where he was employed at Ryan for 6 months while preparing to re-establish his machine shop with his brother-in-law, Pete Redosevich, the assistant manager.

Experts in their field, they now make tools and dies for Ryan, and use their drills and punch presses to produce such items as flange-tooling tubes and guide-tie rods. Other machines nearby might at the same time be turning out plastic ukeleles or fishing reel knobs.

The little businessman, who has made a science out of a specialized, comparatively small piece of work, again is swelling the nation's industrial strength.

Ryan Chemist Develops Better Polishing Compound

The problem of polishing aluminum without materially reducing the thickness of the metal has been licked at Ryan Aeronautical Company.

Fearing the loss of some of the vital 2S aluminum coating, Boeing Airplane Company requested that none of the conventional polishing agents be used on the C-97 aft fuselage sections being built by Ryan. The Ryan engineering laboratory then developed a new non-abrasive polish.

Designated by the developer, B. W. Floersch, chemical research engineer, as Raco 220, the polish removes the vari-colored stains from aluminum skins acquired in the fabrication process, and provides a uniform sheen that approaches mill finish appearance.

This is accomplished without any abrasive action which might thin out the 2S pure aluminum coating over the 24ST dural base alloy. Floersch explains that the stains which this new polish attacks successfully are surface mars and are not the corrosion type which requires an abrasive polish.

Raco 220 is applied on the C-97 aft fuselage sections for strictly esthetic considerations, to turn out a finished product that does not appear dingy with inevitable factory surface blemishes.

Since its use, however, Raco 220 has been found also to have an anti-corrosion value. This has been demonstrated on the huge external fuel tanks being built by Ryan for combat planes. The new polish is applied to the external skin surfaces, particularly along the seam welds.

"We found that it removes the copper which is picked up from the rolls of the seam welder," Floersch explains. "Copper and aluminum make a corrosive electrical cell, and use of Raco 220 inhibits such 'galvanic' corrosion by removing the offender, copper.

Boeing representatives have expressed such satisfaction with the polish results that after the engineering laboratory had started producing it in 5-gallon lots, the demand became so great, a chemical manufacturing company is now furnishing it in 100 gallon quantities to Ryan's formula.

Raco 220 contains 4 pounds of 400-mesh silica to the gallon, suspended in a water solution. The unusually high content of the fine mesh uniform grain silica gives a "roller bearing" action—the polish literally "rolls" over the surface without grinding into it.

An organic suspending agent is introduced to keep the polish from "packing." Phosphoric acid in the polish passivates the aluminum and helps prevent formation of black smut, such as occurs in most polishes. A buffer of disodium phosphate in the polish reduces the corrosive power of the phosphoric acid. Aluminum samples exposed to the polish for a month showed no signs of tarnishing or loss in weight.

Ryan has found this polish ideal for removing stains in newly fabricated products. Obviously, it is not abrasive enough to remove heavy corroson, Floersch points out.

The polish is applied to the skins during final assembly clean-up by means of a cloth pre-dampened with water. Gentle pressure applied to the cloth is all that is required. After a section has been cleaned, the polish is removed by means of a moist cloth. It is not necessary to remove the polish with a stream of water as is required on many commercial acid polishes.

KANSAN, TEXAN, CALIFORNIAN NAMED "FLYING BUSINESSMEN"

The spring months drew sparkling performances from entrants in the Ryan Flying Businessman-of-the-Month Contest, the continuing competition being conducted to determine the Navion owners who use their planes the most for business.

Foremost feat has been the double-victory of L. L. Hoover, furniture store manager and funeral director of La Crosse, Kansas. Hoover captured April honors by flying 87 hours 20 minutes, then earned the Flying Businessman-of-the-Quarter prize by logging 213 hours 25 minutes during the period of February, March and April.

He was presented his awards at a special civic luncheon arranged in his honor at the La Crosse Chamber of Commerce, July 5. Don Pratt, President of P-T Air Service, Ryan Navion dealer in Hays, Kansas, through whom Hoover acquired his plane, presided at the ceremonies. William P. Sloan and Walter K. Balch, Ryan field representatives, extended personal congratulations for the company during a stop-over at Hays on their recent tour through the central states.

From La Crosse Hoover flies on buying trips and other business to all parts of the Midwest. As the only embalmer in his county, he is also subject to calls at all times from the towns surrounding La Crosse. In such instances, even though he be off on a buying trip, his plane enables him to return promptly to meet the pressing need for his help. Emergency ambulance flights with the Navion form one of his many contributions to his community, which he serves as mayor.

Texas Rancher

Most recently named champion is Howard T. Martin, cattle rancher hailing from El Paso, Texas. Martin turned in 98 hours 54 minutes for May, a record monthly total. Presentation of a bronze plaque will be made at an early date by the Mueller Brothers who operate Southwest Air Rangers, El Paso Ryan Navion dealership. Martin is the second of their customers to be named the Flying Businessman. Hal Harman, welding company president, first turned the trick in December.

California Manufacturer

James C. Thomas, 33-year old president of the Utility Tool and Die Manufacturing Company, Pasadena, California, won the March title for his total of 81 hours.

Learning to fly at the end of World War II, Thomas took to the air in 1946 to develop sales for the specialized parts

James C. Thomas (left), March flying Businessman-of-the-Month, receives his award from Vice President E. D. Prudden.

which his company manufactures. Subsequently his plane's most concentrated usage has been on short hops about greater Los Angeles, one of the nation's fastest growing and most traffic-ridden areas, where he shuttles between factories at Glendale, Inglewood, Hawthorne, Santa Monica, El Segundo, Culver City and Burbank.

Thomas flew to the Ryan plant to receive his award from Vice-President Earl D. Prudden.

In an emergency L. L. Hoover, April's champion, uses his Navion as an air ambulance with room enough for nurse Louise Ficken to attend patient during flight.

STOCK IN TRADE

(Continued from page 8)

ply just the right amount of material to fill a requisition and no more.

Further, when they receive a requisition, they first check their stock of cut-offs from previous requests to see if the latest "rek" can't be filled from that source.

Heavy sheet stock stored in eight foot high stacks is gingerly moved around the room with a 6,000-lb. capacity overhead crane called a "sheet lifter." The electrically-operated crane resembles a set of three giant ice tongs.

Bar stock of stainless steel and aluminum is kept in a two-story geometric checkerboard of bins from which attendants draw material as needed. Castings and forgings of carbon, alloy and stainless steels, of aluminum and magnesium are also stored in these easily accessible bins. Other tenants of the bin spaces are the host of extrusions and formed sections which become the vital stiffeners for C-97 fuselage sections, external fuel tanks and Navions. The steel tubing used in exhaust systems, phenolic insulating block, plexiglas, tubing for hydraulic systems, and other special materials have additional storage space of their own.

Most unique stores arrangement, perhaps, is that devoted to paints. Here lacquers, rubbing compounds, primers, shellacs, dyes, cleaners and thinners are kept. Because of the inflammable nature of these items, the Paint Stores area is especially insulated against spark and heat. Lights are installed in insulated mountings. Telephones are encased in non-conducting, no-spark shells. Spark-proof switches are used on all motors and lights. Whenever possible, switches are located outside the building. All barrels are grounded, and tools and chains are of brass or bronze. Smoking is taboo.

Bizarre looking machines also single out Paint Stores from other stores operations. One is a violently jerking "paint agitator" which mixes paint far better than any hand method. Another is the "barrel mixer" which is much akin to the rolling cylinders placed in midway fun houses to turn holiday revelers head over heels.

Purchased Parts Stores is the division designated to receive and store items manufactured by other companies that are to be included in Ryan products. Intricate code books help in keeping perfect control of the thousands of parts purchased from suppliers across the nation. Rivets, bolts, cables, fittings, screws, flexible tubing are just a few of the most

(Continued on page 21)

common materials on the long list. An orderly arrangement of bins and shelves holds most of these myriad items.

GFE Stores — Government Furnished Equipment—also a responsibility of Purchased Parts Stores, is handled quite differently than ordinary materials. A special storeroom is allotted exclusively to GFE and a separate Kardex system maintains perpetual inventory. Unlike other materials, GFE is stored according to contract rather than type of material. A combination-lock vault protects materials with a Confidential classification.

Another of Purchased Parts Stores' duties is to heat treat certain rivets, ice box others, and see to the dyeing and storage of rivets before they are sent to production.

Together, Raw, Paint, Purchased Parts and GFE Stores are concerned with more than 35,000 items.

Harold Hauptman, Assistant Supervisor for Tool Cribs, has charge of six "Stores" spotted throughout the plant for the convenience of machine operators. The cribs are sources for perishable tools like drills, reamers, taps, dies, jigs and fixtures; for pneumatic tools such as air guns, squeezers, grinders and impact wrenches; and for such others items as glass, bandsaw stock, gloves and tapes. Material control of all tools is maintained by Hauptman's office, nerve-center of tool supply.

CARE of raw stock like angle irons, pipes and bar steel, which go into jigs and fixtures, is, along with tool repair, an additional responsibility of the tool cribs.

Parts fabricated or assembled within the Ryan organization comprise the materials handled by still another important Stores department: Manufactured Parts Stores. Frames, skins, stringers, jet parts and manifold stampings are good examples of fabricated parts received by MPS for storage and subsequent forwarding to production departments for additional sub-assembly or for the final assembly job itself.

The storage procedure for manufactured parts is simple and efficient. Material comes to Manufactured Parts Storeroom No. 1, for example, on a standard document called a "shop order traveler." First it is counted, then properly stocked. The traveler is recorded in a perpetual inventory to insure reliable material control. This record indicates the amount of the material received, where it has been stocked, and the current balance of the material on hand.

Every type of factory in-plant transportation, including trucks, lifts, cranes and elevators, is used to quickly move materials needed in production departments. Most materials are picked up by dispatchers at one of the five Manufactured Parts storerooms. When an item that is in short supply on the production line is received by Manufactured Parts Stores, dispatchers are notified that the parts are available and replenishing stock is soon on its way to mechanics and assemblers.

Supervisor R. M. Passenheim keeps close personal track of production schedules in order to anticipate future equipment and space needs. Business is heavy at each of his five stores. In a single day, at No. 1 (airplane stores) for instance, about 280 items are issued. Nearly as many are received. The next day perhaps, a few more will be received than issued. Always the total moved is great. Storeroom No. 2 is for manifold assembly parts and handles an equivalent amount of material.

Stainless steel stampings from the drop hammers go in large quantities to No. 3. No. 4 is shipping accumulation, where finished products are gathered for forwarding to Shipping as customers' delivery dates arrive. One of the biggest stores operations is No. 5, recently set up for jet engine parts, and due to grow in importance as work progresses on Ryan's new 75,000 square foot building being erected for jet components manufacture.

UP-DATED NAVIONS

(Continued from page 17)

stalled, as are a military-type full-gyro instrument panel, an exterior baggage door and reverse-flow cabin ventilator.

The airplane is then sent to the paint shop for complete stripping of all old paint, both inside and out. Final touch is the installation of luxurious new upholstery and application of exterior blue and ivory paint.

Beach reports that four pilots are regularly assigned to flying the Navions. In coming months he expects to keep five of the modified Navions on the shuttle run, with the sixth stationed at Washington, D.C., for use of the company's eastern representatives in their contacts with Wright Field and other Air Force and Navy bases.

The two Super Navions operate out of Los Angeles and Columbus, Ohio, for administrative and engineering executives.

"But our operations aren't all of the concrete runway variety," says Beach. "The Navions have proved themselves plenty rugged on the occasions when we have had to rough it, as a couple years ago when an accident involving some of our personnel occurred just north of Bakersfield. We landed in a cotton field full of ruts and fissures, with only 1,500 usable feet to deliver investigators, engineers and portable radio equipment to the scene. Johnny Typer and Bud Poage piloted the two Navions we used successfully in this emergency."

Most Powerful U. S. Turbojet Takes to the Air

The most powerful turbojet now flying in the United States is carried aloft on a test flight by a specially-rigged B-50 Superfortress bomber. The engine is the J-57 Turbo-Wasp built by Pratt & Whitney at East Hartford, Conn. The J-57, an axial-flow design, is housed in a retractable nacelle that is lowered from the plane's bomb bay for test work. This B-50 Superfortress is the largest plane in the flying test bed fleet used by Pratt & Whitney Aircraft for early experimental flight test of new jet engines.

Developed for the U. 5. Air Force, the J-57 Turbo-Wasp will power important new military planes still on the "secret" list. The J-57, which is still under development, is much more powerful than the Pratt & Whitney J-48 Turbo-Wasp rated at 6,250 pounds static thrust plus afterburner power.

Pratt & Whitney is one of the principal jet engine manufacturers for which Ryan builds stainless steel precision parts under sub-contract.

PROGRESS REPORT ON CERAMICS

(Continued from page 13)

service evaluation. This system has accumulated 800 hours to date.

Newly designed "siamese" ejector stack systems, developed by Convair and Ryan engineers, based on experience with the Pratt & Whitney engines, will be completely ceramic-coated, inside and out, as they are installed in American Airlines' entire fleet of 79 Convair 240's to replace the old "triamese" systems. With spares, this will amount to approximately 200 engine sets for the twin-engined planes.

In "siamese" ejector stacks, valve overlap conditions, with resultant high back pressures, are minimized. Under the present "triamese" system, two front cylinders and one rear cylinder, or two rear cylinders and one front cylinder are picked up in each weld assembly.

An appreciable gain in horsepower and engine life is obtained by use of the ceramic coated "siamese" stacks, in which each section picks up only two exhaust ports. Each side of the engine has 5 major stack assemblies, instead of 3 as in the "triamese" system.

Pan-American World Airways and Western Air Lines also have ordered the new fully ceramic-coated Ryan "siamese" exhausts for their Convair 240's, totaling 26 planes in service.

Engines of the new advanced Convair-Liner, the 44-passenger Model 340, will be equipped with "siamese" exhaust systems basically the same as in the Model 240. The principle of ceramic coating thus will be applied to 100 more plane sets, or 200 engines. Convair has that number of 340's on order from several airlines.

American Airlines is service testing two engine sets of the present "triamese" exhaust systems, fully ceramic-coated, on one of its transports.

Ryan also has received experimental orders from Pratt & Whitney to manufacture exhaust systems, fully ceramic coated, for its latest R-4360 series engines, using 19-9DL stainless steel or 310 modified stainless steel. These engines are used in Boeing C-97's and B-50's and Convair B-36's.

CERAMIC coating is being considered for exhausts of ground vehicles, as well as planes. Continental Motors Corp., for which firm Ryan supplies exhaust systems, is experimenting with a ceramic-coated manifold used in tank engines. Continental plans to examine the manifold after approximately 1500 hours in a test stand.

Ceramic coating is also being considered by the Douglas Aircraft Company for possible use on their DC-6 type ejector exhaust system.

Ryan engineers foresee the time when all exhaust systems will carry the added protection of ceramic coating, a thin "film" of .001" to .003" providing amazingly improved serviceability, efficiency and long life to the hottest portion of the power plant.

Ryan Awarded Contract for Rocket Motors

Expanding the scope of its operations in the manufacture of rocket engine components, Ryan Aeronautical Company has recently been awarded a contract by Douglas Aircraft Company to produce a small number of complete rocket motors for a surface-to-surface missile under development.

According to Ryan production experts, long experienced in building the "hot end" of jet and piston engines, the rocket motor for the surface-to-surface missile presents new problems in forming and welding heavy gauge materials.

The outer shell and other sheet metal portions are drophammer stamped to very close tolerance. Both arc and electric resistance welding processes are used, and furnace brazing is also employed. Certain of the major components of the motor are precision machined from solid stainless steel billets.

The missile is a project of the Army Ordnance Corps and its development is under the direction of the Jet Propulsion Laboratory of Caltech.

G-E'S JET GIANT

(Continued from page 2)

and the six-jet Boeing B-47 "Stratojet" bomber.

Vice President Lang cited the engine "as an outstanding example of the progress of the turbojet art. Only three years ago we first showed our J-47 engine. Today we have an engine the same frame size as the J-47 but with a thrust output so much greater that it isn't even in the same class. Research engineering and manufacturing achievements since 1948 have made the difference."

Neil Burgess, Jr., assistant manager of engineering of the G-E Aircraft Gas Turbine Divisions, said the "21" is an "all weather" engine with anti-icing features and high altitude starting characteristics. It may be equipped for either water/alcohol injection, or for afterburning with greatly added thrust power for short periods. A tailpipe variable jet nozzle may be added to obtain maximum efficiency.

Burgess said General Electric is also working on other new engines including the XJ-53 which cannot be further identified. He revealed that the Advanced J-47:

1. Was developed in record time — 18 months from the time drawings were under way until 50-hour tests were completed.

2. Was designed for best performance compatible with simplicity, reliability and producibility.

3. Combines new designs with battle-tested features of the present J-47.

4. Has a low rate of fuel consumption.

The engine has a so-called "cannular" type of combustion system consisting of a single combustion space containing individual "cans." Some accessories, housed in the nose in current production engines, have been placed underneath to provide a greater air inlet area to the compressor. The compressor — which forces air in great quantities to the combustion chambers — combines high air flows, high pressure ratios and high efficiency with a minimum number of stages.

The company considered development of the compressor so significant that it bestowed its highest employee honor, the Coffin Award, upon two of the engineers responsible for its basic design — Russell Hall and William Cornell of the Aircraft Gas Turbine Divisions.

Burgess said the turbine is connected directly with the compressor. The basic engine control is a hydraulic system, which proved itself on other model G-E engines. Exhaust temperatures are controlled electrically. The oil is cooled by engine fuel and is contained in a tank on the engine.

"Hot noses," achieved by bleeding hot air from the compressor to hollow nose parts, and retractable air inlet screens are used to prevent ice collection on these critical parts.

With modification of accessory mountings, and other minor changes, the "21" will become the J-47-GE-29. Addition of an afterburner forms the J-47-GE-31. The basic engine is 36.75 inches in diameter and 146 inches long.

PODS P.D.Q.

(Continued from page 5)

pushed the job through production. His men worked with tool planning to get enough information available (lacking full engineering data) to begin building detailed parts. Small sub-assemblies were constructed while the tools for such major parts as the crease ring and blister assembly were being made.

"We worked on anything we could lay our hands on," Litell said. "It so happened that engineering information on the parts we required first, due to the sequence of installation, could not be obtained until the very last. So we concentrated in the early stages on building quite a few sub-assemblies."

Ray Doherty, assistant foreman in the daytime, and Doug Beebe, assistant foreman on the night shift, allowed no time interval between their duties. They literally worked around the clock, meeting each other as one went off duty and the other came on each day.

When the first blister assembly—the boom operator's compartment at the bottom of the pod—was removed from its jig, it was still incomplete. But precious time was saved by placing it into the main assembly fixture on March 30, perilously close to the deadline.

In unorthodox manner, this portion was being completed while the main structure of the pod was being worked on simultaneously.

"In full production, the blister assembly will be completed before going into the main assembly fixture, but we had to use all kinds of short cuts to save time on the first pod," Litell points out.

On March 28, the workers began installing detailed parts in the main assembly jig. On April 4, the pod structure was transferred to the pickup station, a cradle in which better access was obtained for completion of riveting and installation of certain parts.

AS the inevitable tooling irregularities of a new project were noted, tool builders would make the required modifications on the spot. When detailed parts were not formed perfectly, production control rushed new parts through fabrication. Dispatchers and follow-up men got the parts to the right place at the right time.

"The fine cooperation of all departments was the only reason we were able to meet the delivery time," Litell explained.

"This never could have been accomplished if we went through routine channels. For instance, suppose tool planning had waited until all the engineering data were available, as is ordinarily the case? We'd still be building tools for the first pod. The job wouldn't have been completed until August or September."

When a bulkhead, produced by a Ryan supplier in Los Angeles because the San Diego plant's hydropresses were operating at capacity, developed a tendency to crack, three key employees flew to Los Angeles in a Ryan Navion.

Edward Oberbauer, foreman of jet engine assembly in Ryan's metal products division, was pressed into service as pilot. He flew Edward Martin, supervisor, airframe planning, and Adolph Bolger, drop hammer and heavy presses foreman, to the Los Angeles factory in an effort to lick the difficulty on the spot.

Bolger discovered that the part was not being properly prepared for forming. It needed additional trimming on the flange and polishing on its edges. Bolger performed this work as he made three bulkheads himself, and left instructions on future fabrication to avoid cracking.

The work was done in two hours, the bulky parts were loaded into the Navion, and flown to San Diego the same afternoon.

This was another example of the ceaseless bottleneck-cracking.

On April 6 the big moment for installation of the pod on the fuselage arrived. This would be the test of accuracy of the tooling.

The pod slipped into the cargo door cavity with perfect fit. Of equal importance, the aft fuselage section with pod underwent its structural pressure and leak tests with no leakage on April 8, a Sunday. It was a triumph of teamwork.

Crews continued to work feverishly April 9 and 10 to complete the "cleanup" details. On April 9, jig builders were still working on the last tool needed to finish the pod, a drill fixture. On the afternoon of April 10, while one man was spray painting a preservative coating for the railroad trip to Seattle, another was giving the pod final finish inspection.

In the glare of floodlights the night of April 10, the first production pod for the KC-97 flying tankers was loaded on a gondola car at a Ryan freight siding.

As it went aboard, before the midnight deadline, a worker who had been on the job almost every day, including Easter Sunday, for the last few months, sighed:

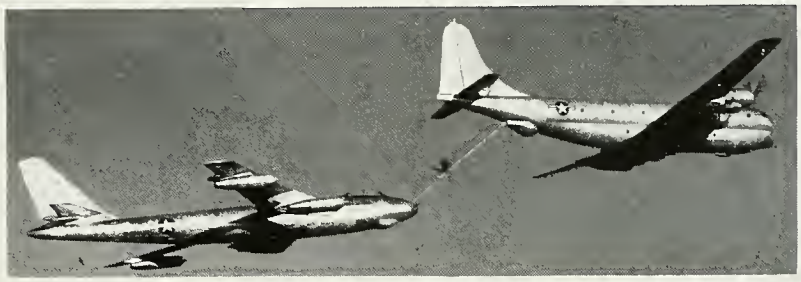
"I didn't mind working 20 hours a day. But when they asked me to work 22 hours, I figured that was too much. It would interfere with my fishing."

Initial Stratojet Mid-Air Refueling Tests

Greater range for the 600-mile-an-hour Boeing B-47 Stratojet bomber has been provided with the recently-tested Flying Boom system of aerial refueling.

Seen here in the first released photo of the initial Stratojet tests of the now-standard U. S. Air Force refueling system, the sleek six-jet B-47 is hooked up to a double-deck Boeing KC-97A Stratofreighter tanker.

The telescopic, swiveling Boeing-developed Flying Boom is controlled by tiny vee-shaped "ruddevator" control surfaces, actuated by "Clancy" (the man who "lowers the Boom") from his station under the tail of the big tanker airplane.

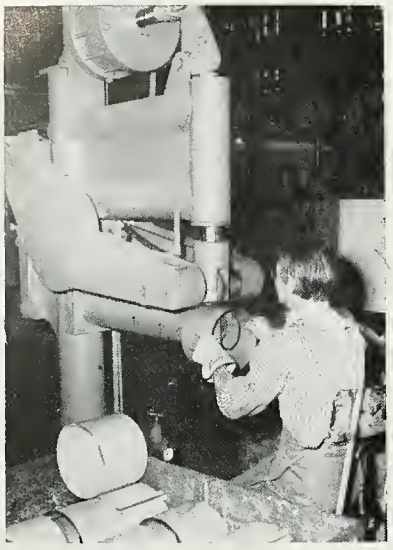


The pipe is actually "flown" into a slipway coupling in the nose of the jet bomber and fuel is pumped at high speed from the Stratofreighter to the Stratojet.

Jet airplanes, notorious for their fuel appetites, now will be able to greatly extend their operating range through use of the Flying Boom system.

Ryan has an important role in the B-47 aerial refueling program. Its Metal Products Division makes tailpipes for the B-47 jet engine pods and also builds tailcones, combustion chambers, transition liners and other components for the J-47 General Electric jet engines which power the Stratojet bomber.

For the KC-97A flying tankers Ryan makes the aft fuselage sections and is also in volume production of the refueling "pods" which replace the rear cargo doors when the Stratocruisers are fitted as tankers.



IT'S TEN TIMES FASTER

A special seam rolling machine, designed and built by Ryan's plant engineering department, is stepping up the job of smoothing weld seams by 1000 percent. Especially designed for the work, this new machine is used to flatten the Heliarc welded seams of stainless steel exhaust sections. These sections are large tubular parts which have been welded into circular form to serve as aircroft engine exhaust components.

Formerly, these parts were welded with filler rod added and the resultant bulge of metal at the seam was ground away by hand, using a power-driven grinder. This involved substantial time required to remove excess weld metal and obtain a smooth finish.

With the new seam-roller, it is now possible to weld the sections by Heliarc without using any filler metal. This provides less excess metal to be removed. The welded sections are placed between two steel rollers in the seam roller and the heavy pressure of the rollers exerts a purifying actian while at the same time flattening the weld seam and improving the weld quality by refining the grain structure of the metal. Only a few seconds are required to run each section through the machine.

The seam-roller is operated by a ½ h.p. electric motor. The operator simply places the part between the two rollers and depresses a foot switch. This actuates an air cylinder bringing the upper roll dawn against the part and the lower roll. A pressure aperated switch in the oir line automatically starts the motor and the upper roll causing the parts to be drawn between the rolls. Pressures of as much as 20,000 pounds can be applied to smooth the seam.

DOUBLE-DECKER

(Continued from page 12)

radial engines, Ryan manufactures comlete exhaust systems of type 19-9DL corrosion-resistant steel which incorporate provision for powering turbo superchargers.

Because the base metals used in the exhaust system are subject not only to temperatures as high as 1700°F. but also to corrosive action of the exhaust gases, Ryan now makes exhaust systems for the Stratocruisers with thin ceramic coatings, greatly extending their service life.

In the very nature of the commercial air transport business, in the frequency of overhauls and engine checks required by the CAA, the transport plane must undergo a great amount of maintenance work. One of the great aids to giving the Stratocruiser more time in the air and less time in the hangar is the use of complete power packages. These power "eggs"—assembled by Rohr Aircraft Corp. for Boeing—include the engine, propeller, Ryan exhaust system, cowling and all accessories that go to make up the complete power unit. They can be removed from a plane just in from a flight and replaced, ready for operation, in as little as 37 minutes.

37 96

Of the airlines using Stratocruisers, only Northwest operates the double-deckers in domestic service: coast-to-coast between New York and Seattle, and on local high-density flights between the Twin Cities and Chicago. On overseas flights, the four commercial airline systems and MATS have made over 4400 Pacific crossings and more than 4300 over the Atlantic. More tourists now travel to Europe by plane than by ship!

The Stratocruisers have been found frequently in the world's headlines. Service expansions have added them to regularly scheduled flights to South American points, Paris, Rome, Beirut, Berlin, Frankfurt, the Bahamas and the Orient, to name just a few.

Most recent new service was inaugurated by Pan American only a few months ago when a Stratocruiser dropped in on Sydney, Australia, from California, slicing a neat nine hours off the previous scheduled time for the jaunt in establishing the twice-a-week schedule.

Sydney citizens, incidentally, greeted the arrival of the world's largest commercial transport with wild enthusiasm. Some 30,000 persons created one of the worst traffic jams in Australian history as they swarmed to the airport for a quick look at the new arrival. Similar receptions were accorded the mammoth luxury airliner at Auckland and Melbourne.

Another recent step-up in passenger accommodations was provided by British Overseas March 1 this year when special luxury service was introduced on its New York-London Speedbird route, which is being conducted on a daily basis during the summer months.

FLIGHT records consistently have gone by the board since the Stratocruisers were put into service. Early this year the 2,000-mile jump from Tokyo to Wake Island was cut to 5 hours and 52 seconds, more than an hour faster than the previous mark. The Honolulu-San Francisco trip has been made in 6 hours and 48 minutes, and the New York-London journey in 8:55. The Seattle-San Francisco run has been clocked in 1 hour and 54 minutes, and that from Seattle to San Diego in 3:47.

The big Boeings, fully altitude-conditioned, are divided into two decks, the lower portion fitted with a cocktail lounge and the remaining space divided into two large cargo compartments. The main passenger deck, connected with the lounge by a spiral staircase, has seating and sleeping accommodations for from 50 to 75 passengers, depending on the airline. A well-equipped galley, two spacious dressing rooms and the most complete control cabin ever used in a commercial transport are common to all Stratocruisers.

And there is plenty of room in which to move around while the ship is in flight. One United Air Lines stewardess, for example, recently proved that point by strapping a pedometer to her ankle during a Los Angeles-Honolulu flight. She discovered she had walked four and one-half miles during the nine and one-half hour trip.

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STERLING STEEL

(Continued from page 7)

vestigations have been geared to the needs of Ryan's applications for many years. Recently, Republic changed the deoxidizing agents used in melting type 310 stainless to improve its hot rolling characteristics and resultant surface quality. Several sheets of this special metal were sent to the Ryan Development Laboratories for tests to determine if this altered procedure had improved the forming properties of the alloy.

Reports developed from Ryan's investigations influenced Republic to increase their production of this type of stainless steel and Ryan placed orders for substantial quantities of the improved metal.

Every step in the making of stainless steel is an exacting process and Republic maintains the closest metallurgical supervision over their product from the analysis of the initial scrap to the finished sheets.

In the beginning, only carefully selected scrap material is suitable for making stainless steel alloys because of the extreme quality control which is necessary. Electric furnaces are used to melt the metals down so that constant temperature can be maintained throughout the heating. The huge electric arc furnaces are tapped to pour large stainless steel ingots which are rolled into slabs weighing 2 tons each. These are ground to remove scale and surface defects. The raw metal slabs are then ready for rolling mills which make stainless steel sheets possible.

First, the slabs are hot-rolled in a battery of six tremendous mills which continuously roll the strips from a slab 4 inches thick and 36½ inches wide to a gleaming strip 50½ inches wide and .160 inches thick.

The next process involves the cold rolling of the stainless steel strips. Most of this work is accomplished in Republic's modern Massillon plant where massive rolling mills weighing 1200 tons each and exerting pressures up to 5,000,000 pounds are used. Driven by 2,000 horsepower electric motors, these mighty rolling mills reduce the thickness of the strip down to a minimum of .015". Thin gauges such as this require up to 25 passes through the mills and many intermediate annealing and pickling operations to remove the work hardening which the rolling action produces.

After a final, or "skin pass," the 5 ton coils of stainless steel are leveled and cut into sheets three feet wide and ten feet long for Ryan requirements and shipped in carload lots. Ryan uses gauge thicknesses from .016" to .250" but the bulk of the metal ordered is in the neighborhood of .050".

Ryan needs, based upon the application of stainless steel in handling searing exhaust gases from jet and piston-type aircraft engines, are unusual as compared to other clients of Republic. Exhaust equipment made of the stainless alloys deteriorates and is actually partially consumed during its thousands of hours of service life. When developing a new exhaust system Ryan engineering designers must visualize the metal sheets as forming the walls of a blast furnace and plan the system to provide maximum service life within the weights and dimensional limits specified.

37 96

In practically all other applications where stainless steel is used, the metal can be presumed to last forever, and does. In the food handling industry and chemical plants, stainless steel is selected because of its cleanliness and resistance to corrosion. For consumer goods, such as cooking ware and automobile trim, the alloy is superior because of its beautifully lustrous appearance and ageless life. In all of these applications, the life of the metal is sufficient to remove deterioration as a factor in design.

Because of this vital difference in use, Ryan metallurgists are not as interested in the appearance and finish of the alloy as in obtaining uniform gauge thickness in each sheet. Many fabricating operations, such as forming, sand-blasting and pickling, tend to have a thinning effect on the parts. If the original sheets of metal are not uniformly thick enough to start with, undue thinning may occur in production and cause rejection of the part. This would not affect the utility of a stainless steel car bumper but is extremely important in the life of an exhaust system on an airliner or jet bomber where the part operates continuously at cherry-red temperatures.

Experience at Ryan has shown that a No. 1 finish is desirable for sheets which are to be formed with hammers because the slightly roughened surface of this finish allows the dies to better grip the metal. Ryan specifies this finish for another reason, too, because it involves a light final rolling of the material. Thus, the steel is received in a relatively soft condition which makes it much simpler to form.

Close liaison between steel supplier and the manufacturer of the finished item has proved mutually beneficial as in the case of the research departments of both Republic and Ryan. Such cooperation between industries is a typically American phenomenon which accounts for this nation's leadership in technological progress.

Jet propulsion experts, both officers and civilian engineers, from the Navy Bureau of Aeronautics were among recent visitors who observed advance research work Ryan is doing on new applications of jet propulsion. Representatives of other prime aircraft manufacturing companies have also studied Ryan developments in this field.

Ryan technical personnel are shown above at the control panel of the jet test cell, protected by heavy glass shield which permits observation of operations, as official party watches tests.

Recent Navy inspection groups included Comdr. S. S. Sherby, assistant chief of the BuAer fighter desk; Comdr. H. H. Epes, military requirements; Comdr. J. R. MacLachlan, aircraft systems and Comdr. H. E. Cook, military requirements. Among civilian BuAer personnel was G. C. Danch, design research expert, who at one time was assigned as Navy project coordinator for the Ryan XF2R-2, successor to previous models of the Fireball carrier-based fighter.

RYAN AERONAUTICAL COMPANY
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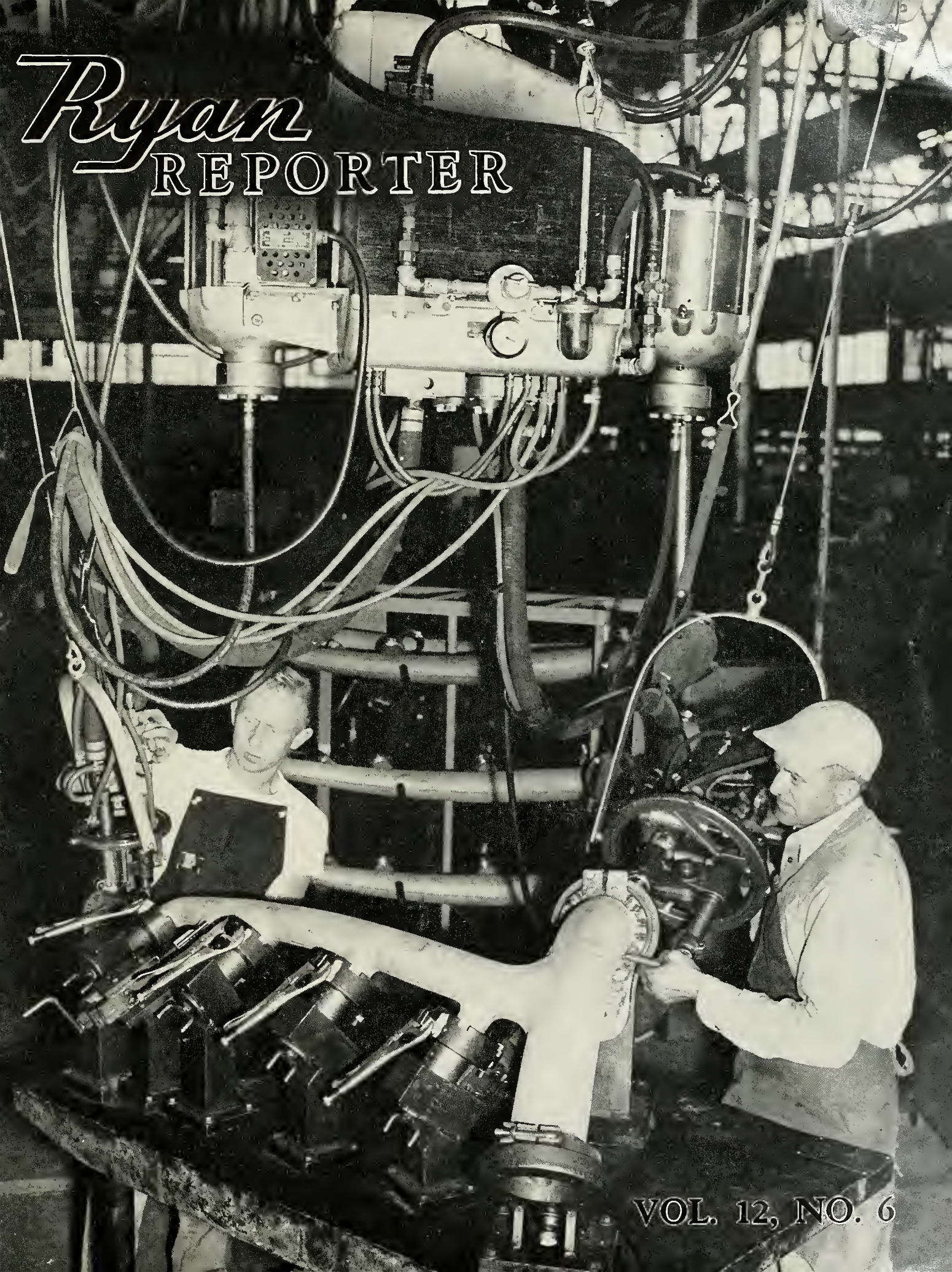


VOL. 12, NO. 6

(Top) In firing formation, these M-46 tanks of Co. A, 6th Tank Battalion, 24th Infantry Div., go into action against Chinese Communist forces in Korea. (Bottom) Installation of Ryan exhaust systems on the 825 h.p. V-12 Continental gasoline air-cooled engine at the Continental factory.

Rolling Fortress

JUST how have American tanks stacked up in combat operation in Korea?

One of the most authoritative reports comes from an Ordnance Corps liaison officer of the Aberdeen Proving Grounds, who made an extensive five-months study in Korea of the operation of the M-46 General Patton tank for the Detroit Tank Arsenal.

Major W. O. Miller reports in the SAE Journal that "from the break-through at Taegu to within 15 miles of the Manchurian border, the M-46 eliminated most enemy opposition and proved itself the most maneuverable tank yet designed." Though the M-46s represented the earliest production designs, they were masters of the situation. With the exception of the Patton tank, practically all other automotive equipment was the same as in World War II, but nonetheless performed very well.

In comparison with the Russian T-34, an 85-millimeter medium tank, the American 90-millimeter M-46 was outstanding in overall performance—maneuverability, speed and ability to resist shell fire.

The 825 h.p. V-12 Continental gasoline air-cooled engine has proven out very well, and the elimination of the need for anti-freeze considerably lessened the logistics load. The Russian T-34 on the other hand uses a 500 h.p. 12-cylinder diesel water-cooled engine, which of course had a greater maintenance problem under the cold weather operating conditions last winter when temperatures reached as low as 15 degrees below zero.

Another great advantage of the American tank has been the automatic (torque converter) transmission which makes pos-

sible a degree of maneuverability never before realized in tank operations. It also makes it possible to train drivers at a much faster pace and measurably reduces driver fatigue.

Compared to the 35-ton T-34, the Patton provided greater armor protection because of its 48-ton weight. Cruising range of the Russian tank is reported to be nearly double that of the M-46, but the American tank, with a speed above 35 miles an hour, is somewhat faster. The increased gasoline consumption of the American tank, however, has been a disadvantage in that it has created one of our greatest supply problems.

The Patton tank is more complex than its Russian counterpart but at the same time is considerably more efficient. The Reds have reduced their installations to the bare essentials—in some cases, below acceptable standards. For example, our instrument panel has over 20 operating instruments and switches while the T-34 has only 6 or 8.

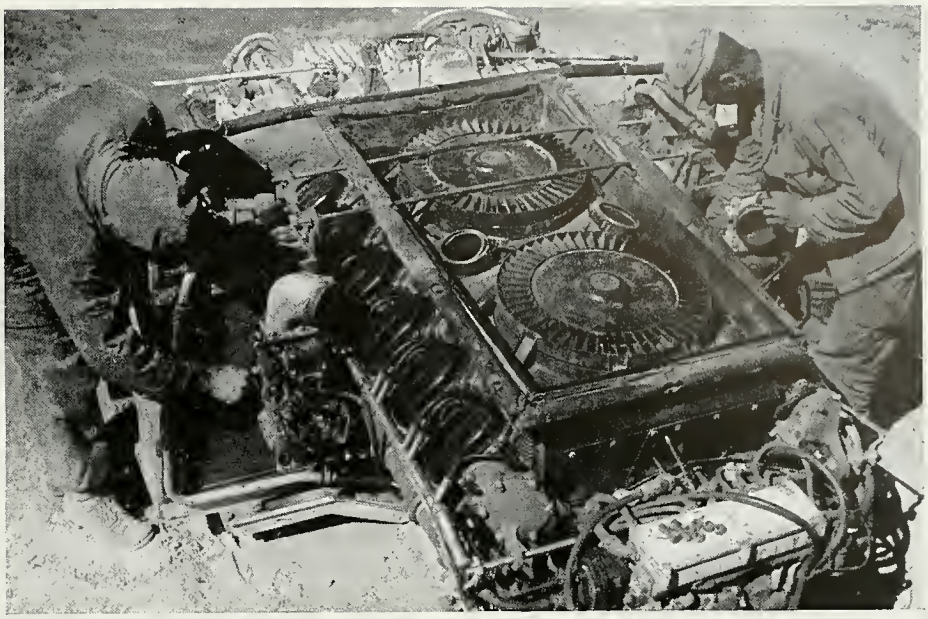
In contrast to the Russian simplicity, the British have gone in for relative luxury, even providing an electrical outlet for heating tea in their tanks—though in this case it is probably a luxury which pays for itself—the British soldier being as devoted to tea as he is.

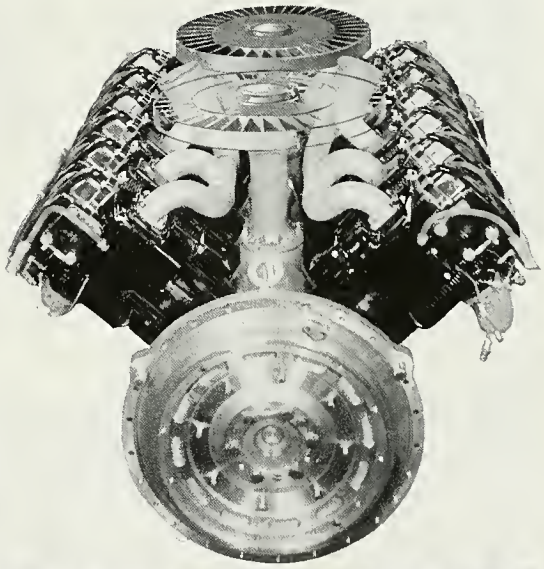
There is, however, something to be desired in the way of crew comfort in the Patton tank in that the tool and accessory boxes, located on the fenders, are not waterproof and no provision is made for storing the crew's few essential items of clothing other than to tie them on the outside.

An advanced version of the Patton tank has recently been put into production by Army Ordnance at its Detroit Arsenal. The new tank is reported as the M-47 and supplants the M-46-1A Though details are still classified, it is known that the new tank weighs about three tons less than the Patton, though probably retaining the proven advantages of the M-46.

Continental Motors and Ryan Aeronautical Company have drawn heavily upon their extensive experience in building for the aircraft industry to give the M-46 tank engines the same desirable qualities which characterize aircraft power plants. Salient features of the

(Continued on page 17)

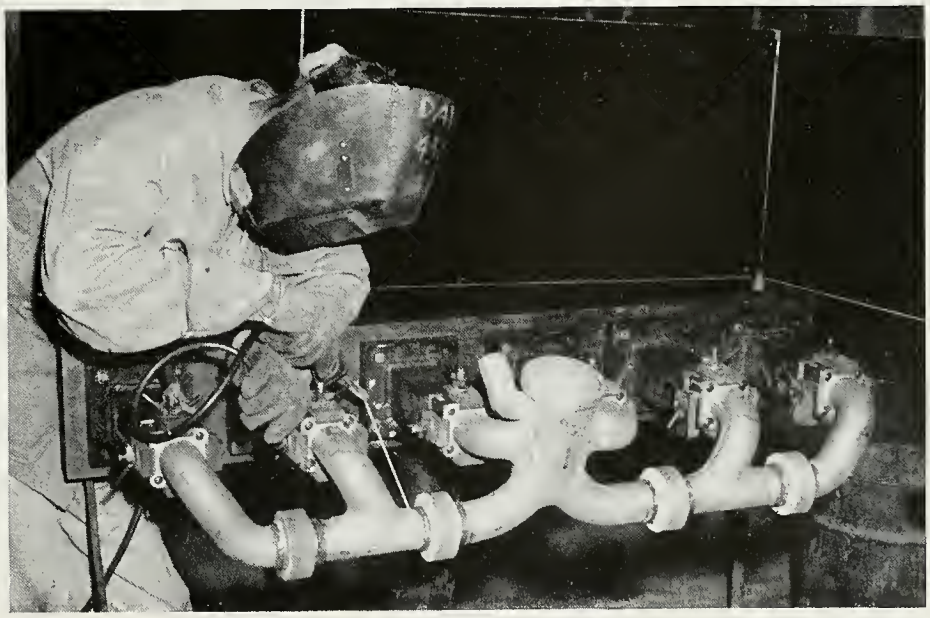




(Top) On-the-spot repairs to M-46 tanks are made in Korea by U.S. Army mechanics of the 30th Ordnance HM Co. Tanks are designed for simplified field service specifications.

(Right) 12-cylinder V-type Continental engine for M-46 tank with Ryan exhaust manifolds. Air cooling fans are sketched in phantom view to indicate complete assembly.

(Lower) Arc welding is used to attach the bellow joints which permit contraction and expansion due to temperature change and make the exhaust system entirely water-tight.



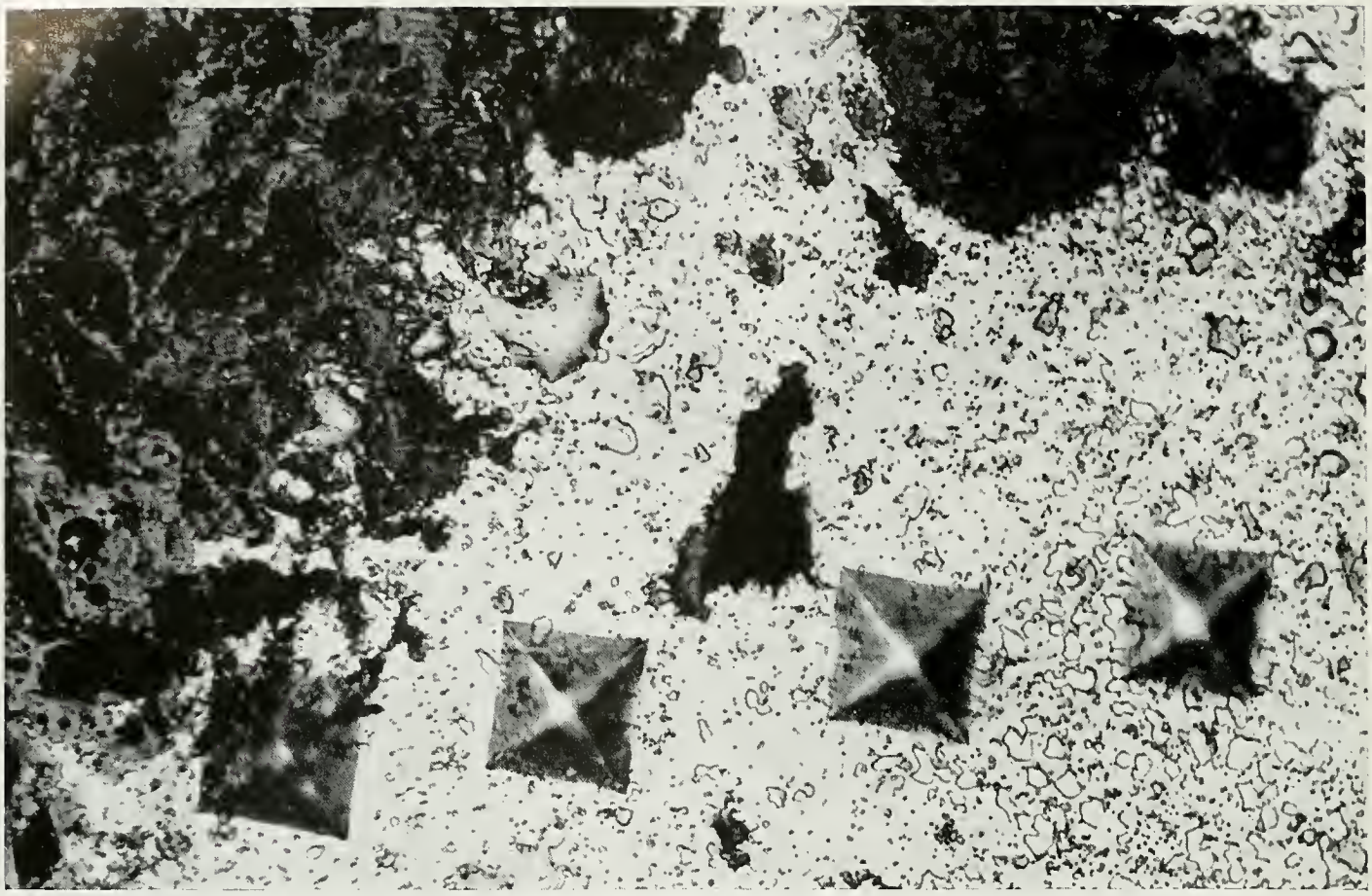
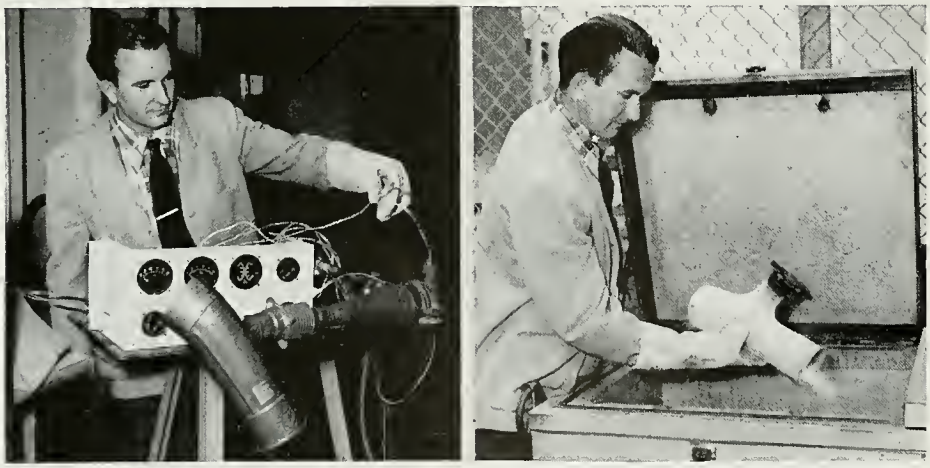


Fig. 2 **Photomicrograph, enlarged 800 times shows hardness test impression to check hardness of metal under ceramic coating.**

Service Tested CERAMICS



(Left) Wilson G. Hubbell, Ryan chief metallurgist, arranges burner set-up for heating a Ryan ceramic coated header to 1700°F. and (right) removes a frosty header, which has been chilled to —70°F., prior to severe thermal shock tests.

SCIENCE is validating ceramic coatings for high temperature aircraft applications. In a revealing metallurgical report, just completed by the Ryan Aeronautical Company's Development Laboratories, the life-extending properties of very thin ceramic coatings on exhaust systems are verified with technical data.

Latest development in Ryan's progress with ceramics, this study discloses the intimate metallurgical changes which occur in ceramic coated exhaust manifolds at elevated temperatures. With an impressive array of photomicrographs, spectrograms, and microhardness readings, Wilson G. Hubbell, Ryan chief metallurgist, points out the significant advantages which ceramic coatings provide.

No deterioration by oxidation, carbon absorption or corrosion attack was evi-

Fig. 1 **Showing decarburized zone under coating and normal carbide distribution.**

Fig. 3 **Evidencing formation of carbide and oxide solution on uncoated header.**

Fig. 4 **Marked intergrannular corrosion appears in this Ryan photomicrograph.**

denced in the ceramic-protected exhaust headers which were tested in actual flight for periods running to 1623 hours. This is the first occasion in Ryan experience where an examination of high temperature headers disclosed no deterioration after substantial hours of service.

This extended life is important both from a standpoint of better service and as a substantial aid in the conservation of critical elements which are in short supply and which are generously used with corrosion-resistant alloys. It means that the so-called "luxury" class of alloys for jet and piston engine applications can in many cases be supplanted by cheaper alloys when given the benefit of life-extending ceramic coatings.

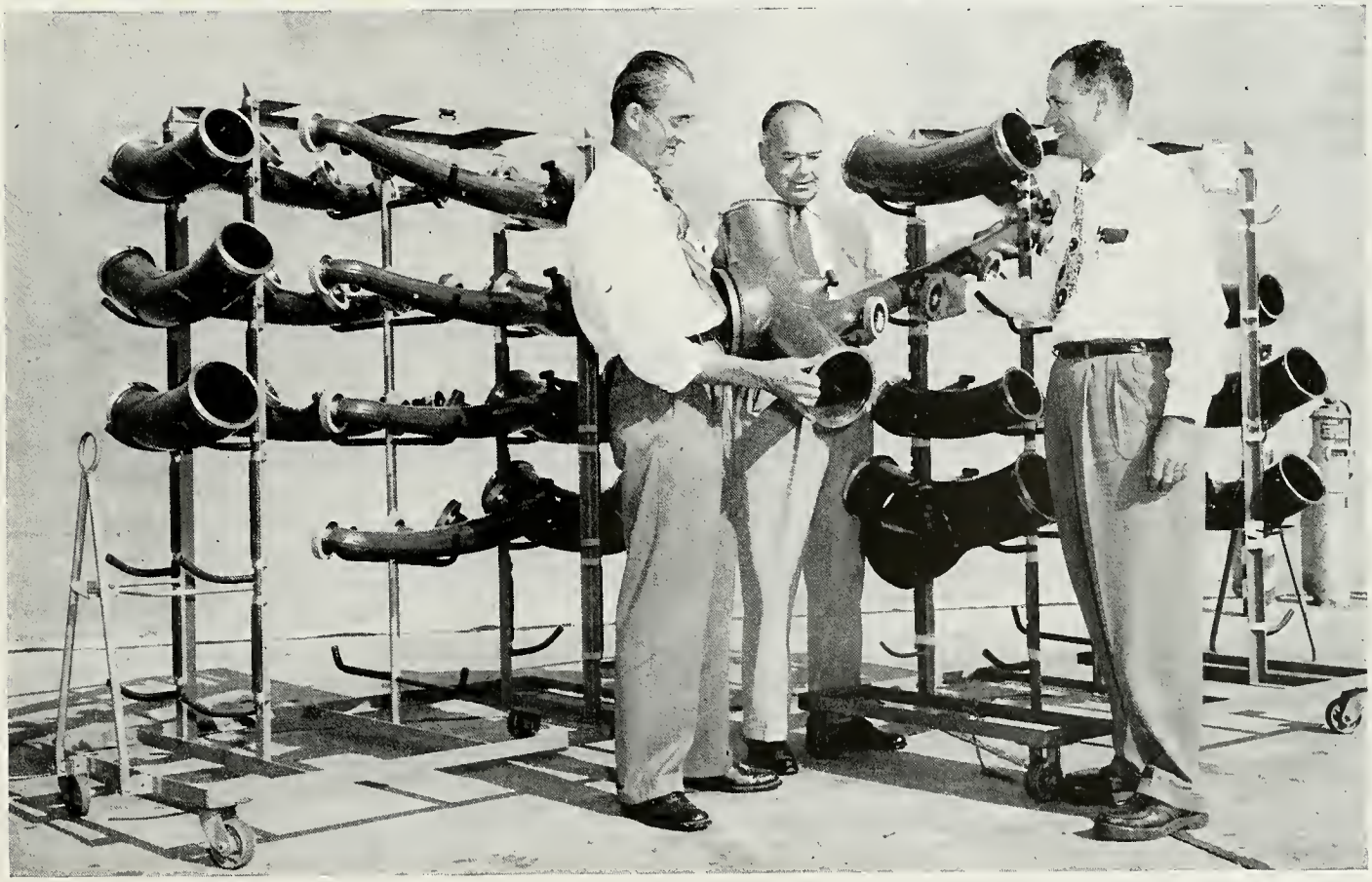
The report also includes the encouraging results of a thermal shock test conducted with the ceramic coated headers. This study shows that the .001" to .002" thick coatings are not affected by thermal shock as encountered in exhaust systems service at any temperatures between -70° F. and 1700° F. and that the ceramic will stand a surprising amount of mechanical impact without sustaining damage.

Several months ago Ryan arranged with Pan American World Airways and the Boeing Airplane Company for the flight testing of the exhaust system headers on the R-4360 Pratt and Whitney engines of Stratocruiser aircraft operating on the transpacific run. Subsequently, a variety of exhaust headers, both coated and uncoated with ceramic material, have been tested and examined to form the basis for the metallurgical report.

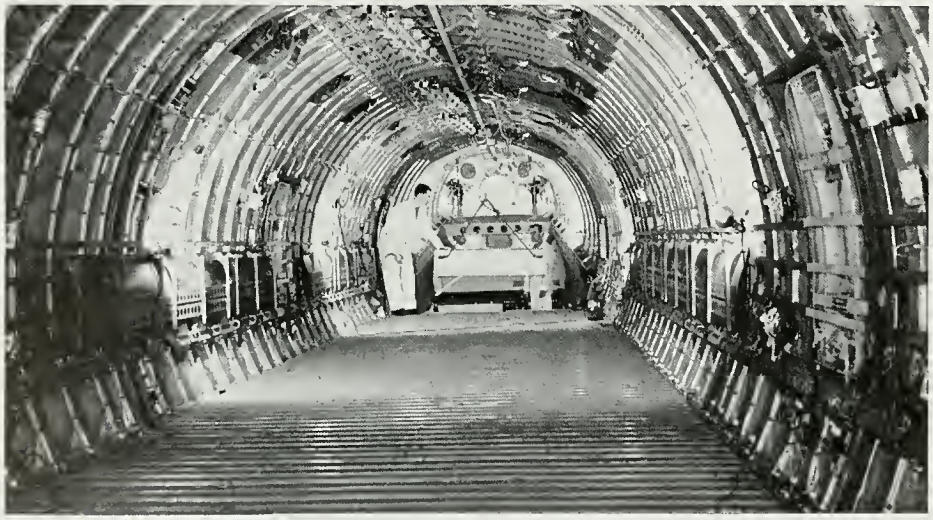
No reduction in thickness was found, by dial gauge measurement, in the headers which were ceramic coated on both interior and exterior surfaces. On the

(Continued on page 22)

(Left to right) F. B. Coffer, metal products; W. S. Cockrell, development laboratories head; and T. C. Hacker, manifold engineer, are pleased with the smooth ceramics coatings which have been applied to these Ryan sections for Boeing C-97 Stratofreighter.



SKY BEAMS



49 Ryan floor beams carry the load under the deck of the Boeing C-97 Stratofreighter. With twice the volume of a railroad boxcar, this 14,000 horsepower teammate of the B-50 can serve as a fuel tanker or 375-mile-an-hour transport.

AIR Force strategists think of their big bombers as "flying gun platforms," or mobile artillery, designed to bring maximum firepower to bear against an enemy. In similar fashion, heavy cargo planes may be considered to be "flying freight platforms" that can airlift essential equipment for an entire Division across the ocean in 24 hours.

A striking example of this type of air cargo carrier is the double-decked Boeing C-97 Stratofreighter whose flying floors can transport 68,000 pounds of freight, including jeeps, trucks and artillery, to a scene of operations. Under the Stratofreighter's sturdy floors, 49 Ryan-built floor beams carry the weight of the cargo which can be packed into the transport's 6,000 cubic feet of usable space.

Fabricated of spotwelded aluminum alloy, these "I"-beams have a remarkably high strength-weight characteristic. They

are joined together with more than 1,000 electric spotwelds which give them maximum strength without added weight. Although simple in design, the beams must be built to precise measurements and handled with exacting care.

First step in the production process is the cutting and drilling of the webs, channels and Z-sections which form the basic parts of each beam. The material used is clad aluminum alloy which is received in the annealed condition so that detailed forming can be accomplished. A 1500-ton hydropress is used to press out the beam structure.

After forming, it is necessary to bring the metal strength and hardness up to a maximum. This is done by heating the parts in a molten salt bath, consisting of a mixture of potassium and sodium nitrates at 925°F., for 30 minutes. The temperature forces some of the elements of the metal into solid solution, producing a strong crystalline structure. Slow cooling of the metal would precipitate these elements out of solution again. In order to retain the "solid solution hardening," at room temperatures, it is necessary to quench the aluminum within 10 seconds after removal from the hot salt bath. This posed a ticklish conveyor sys-

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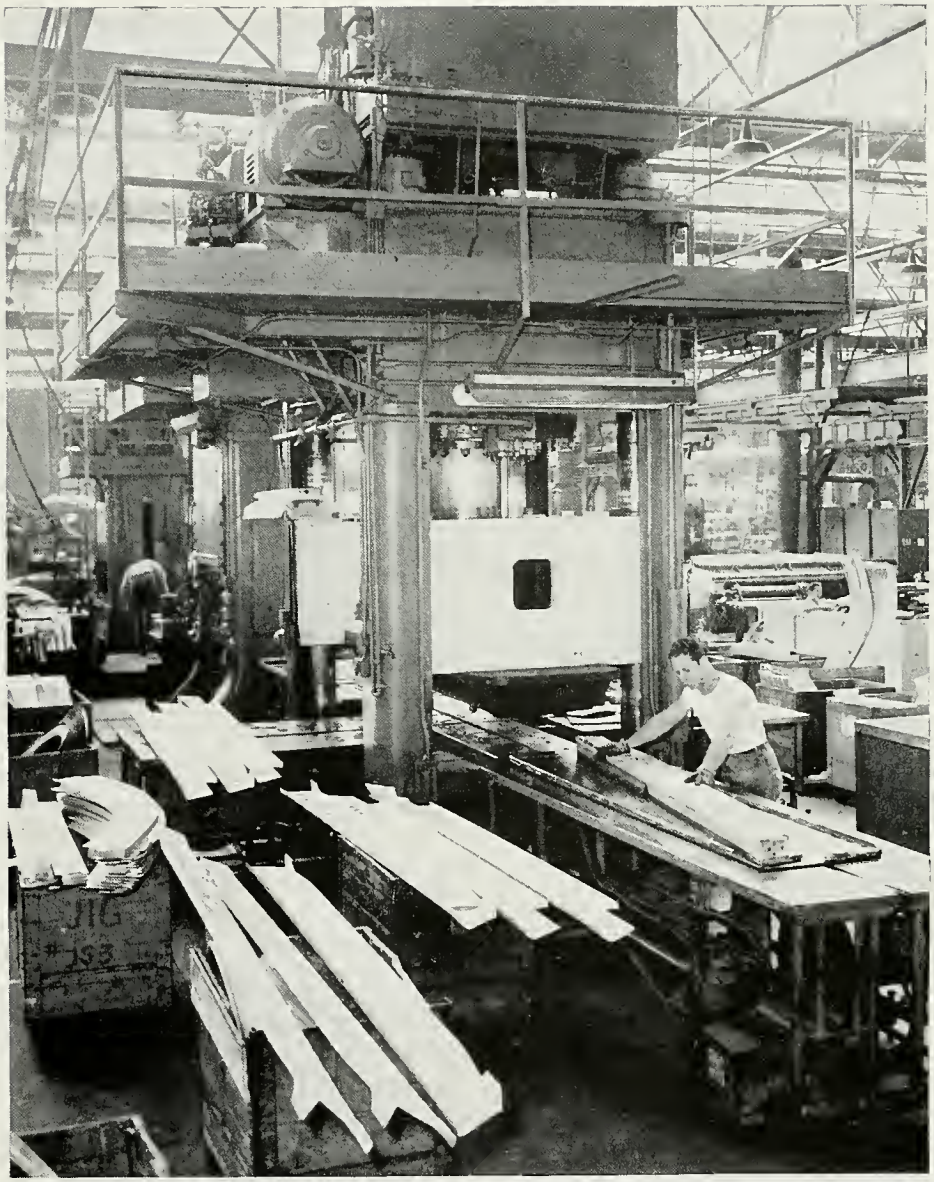
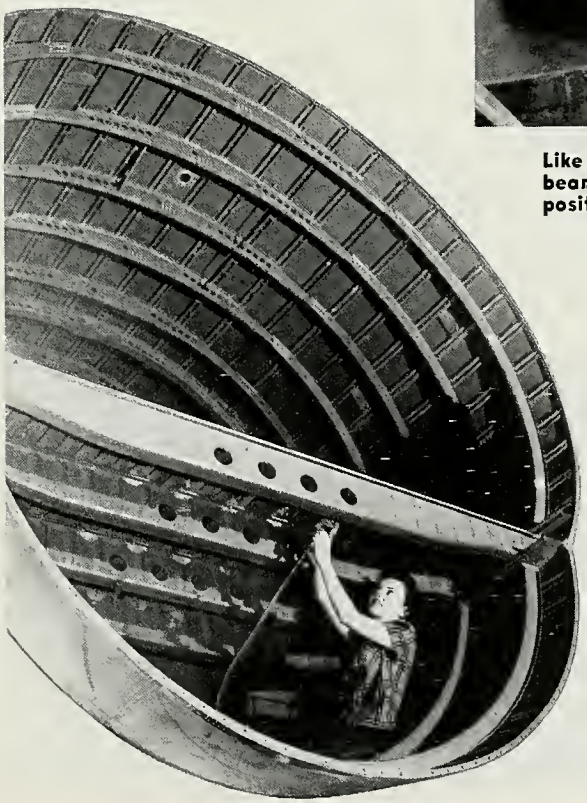


Like pressing cookies out of dough, this 1500-ton Ryan Hydropress molds floor beam web sections to exact structural detail. Elye Korn, hydropress operator, positions the web on a steel die which rolls under the heavy hydropress pad.



Mary Wilson adds a finishing touch to the four floor beams which are installed in each aft fuselage section at the Ryan plant. The balance of 45 floor beams for the Stratofreighter are shipped to Boeing to install.

Ryan-built floor beams are bathed, shaved, trimmed, pressed and manicured before their installation in the Stratofreighter

The historic Ryan M-1, first volume production monoplane in the United States, was used at the outset to carry airmail, but was adaptable to passengers. This first M-1 made an epochal survey of Los Angeles-Seattle route for Pacific Air Transport.

BIRTH OF AN AIRLINE

by Harold Keen, Radio-TV Editor of "People in the News," KFMB, San Diego

THE cocoon from which United Air Lines emerged as one of the world's great air transport services was spun a quarter century ago by men who didn't mind challenging the unknown.

Some of these pioneers had substantial financial resources. Others, like Vern C. Gorst, of Coos Bay, Ore., had more enthusiasm than cash. The enthusiasm was converted into Pacific Air Transport which 25 years ago this September 15th made its first scheduled flight. PAT was one of the four companies (others: Varney Air Lines, Pasco, Wash. to Elko, Nev.; Boeing Air Transport, San Francisco to Chicago; and National Air Transport, Chicago to Dallas and Chicago to New York) which were combined to form United's transcontinental system.

Efficiency and economy of famed M-1 monoplane was emphasized by Ryan advertising 25 years ago.

Gorst not only needed cash. His vision had to be implemented with aviation "know-how", and that was why he came to San Diego more than 25 years ago. Determined in 1925 to start a Los Angeles-Seattle airline with an airmail contract as its backbone, he heard about a

Hazardous night flying featured P.A.T.'s air mail service with Ryan M-1's in 1926. T. Claude Ryan, who made first survey flight of coast route, is shown, center, in photo at right, receiving from W. R. Patrick, left, and William O'Hern, United Air Lines officials, copy of "High Horizons," United's 25th anniversary history. P.A.T. was one of its predecessor firms.

venture called Ryan Airlines, Inc., which flew passengers between Los Angeles and San Diego in the first year 'round regularly scheduled operation of its kind in the country.

Gorst knew transportation, but it was the highway type. He had six struggling bus lines over short routes all the way from Medford, Ore. to Santa Monica, Calif., when he became concerned about the possibility of being put out of business by planes flying passengers and mail right over his vehicles.

With fantastic zeal, he plunged into the organization of a $500,000 company, Pacific Air Transport, and sold stock all over the west. His first and only personal contact with a plane up to then was with one of Glenn Martin's pontoon-equipped "Flying Birdcages", a rather abundantly wired conveyance in which he cracked up in 1915.

The number one objective of Pacific Air Transport was the air mail contract to be awarded by the Post Office Department for the Pacific Coast route. In San Diego, where Gorst went to observe an air line in being, he received some sound advice from the head of Ryan Airlines, Inc., a young ex-Army flier named T. Claude Ryan.

Two pioneers of West Coast air mail operations, Vern Gorst, left, founder of Pacific Air Transport, and T. Claude Ryan, builder and pilot of the Ryan M-1, shown in Seattle after first survey flight from Los Angeles.

"First you've got to know enough about flying for others to have confidence in you," Ryan told him. "You can't run an airline unless you know something about airplanes. You ought to have a pilot's license of your own."

This appeared reasonable to Gorst. He stayed to take flying lessons from Ryan.

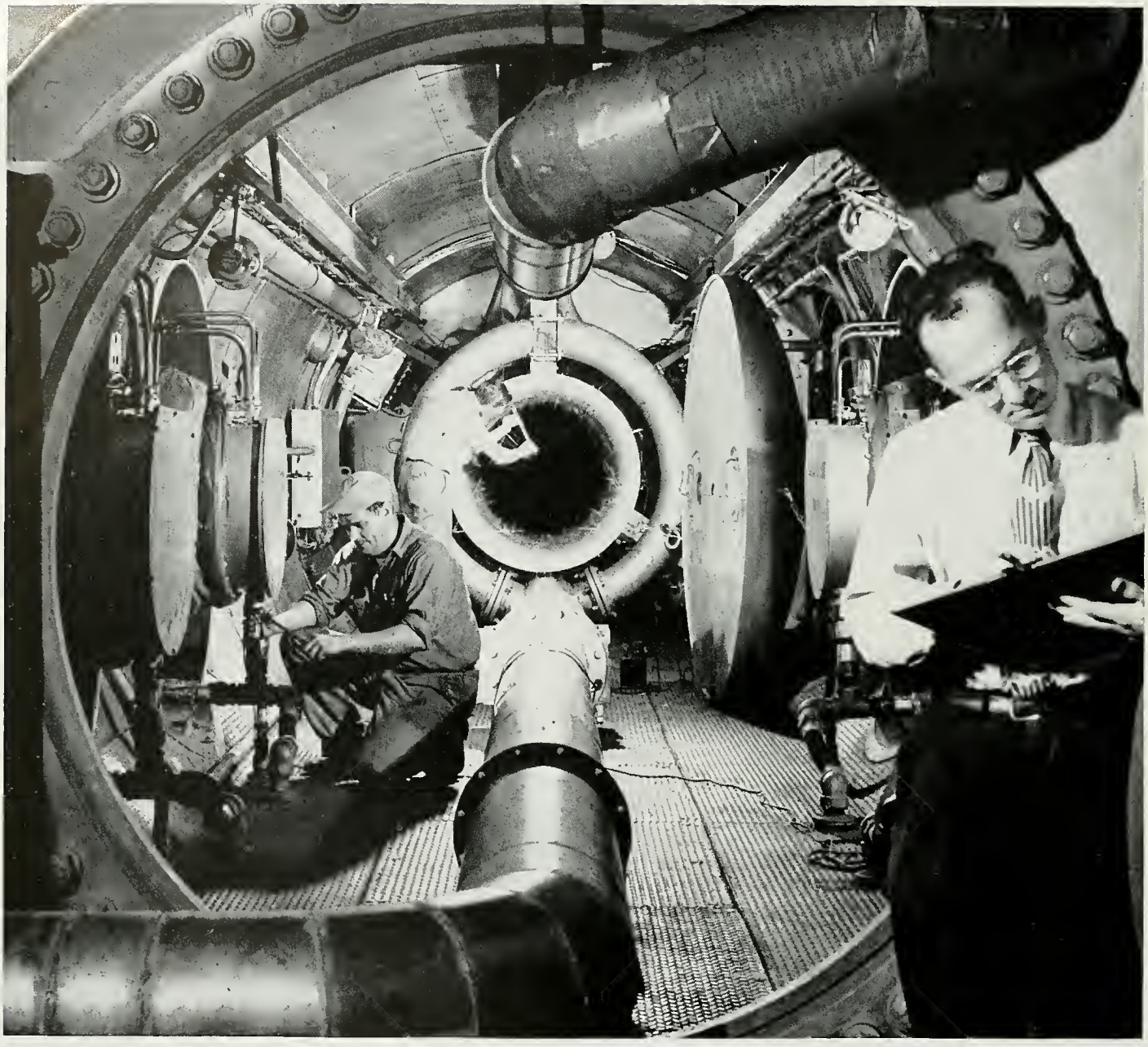
At about this time, Ryan's interest was shifting from airline operations to airplane manufacturing. Gorst's visit to San Diego provided the impetus that launched Ryan, once and for all, into the production of some of the nation's most illustrious aircraft. These were to include the M-1, first volume production monoplane in the United States, the famed Brougham, of which Lindbergh's "Spirit of St. Louis" was a special version, the S-T series of sport-training planes, the PT series of military trainers, the "Dragonfly" observation plane, and the "Fireball" jet-plus - propeller Navy fighter.

Ryan, who considers his association with Gorst a key episode in his career, had been operating a sightseeing and flight instruction service in San Diego since 1922. As his volume of business increased, he needed larger planes, and he replaced his wartime Jennies with Standard biplanes, which were redesigned and made over from 2-place, 90 h.p. training planes to 5-place, 150 h.p. craft in Ryan's own shop.

The airline grew out of the sightseeing and charter business and was

(Continued on page 18)

Passengers board giant DC-6B Mainliner of United Air Lines, one of new fleet on transcontinental and Pacific Coast routes.



Inside their 40-foot steel test tube, General Electric engineers prepare the scene for the "flight" of an experimental jet engine compressor which will "soar" to an altitude of 70,000 feet and experience temperatures running from -100°F. to 100°F.

Moss A G T Laboratory

GENERAL Electric is looking into the future to see the jet engines of tomorrow! Their "crystal ball" is the new multi-million dollar Aircraft Gas Turbine Laboratory built at their River Works, in Lynn, Massachusetts, and dedicated to the late Dr. Sanford A. Moss, famed "father" of the turbo-supercharger.

Designed to explore previously uncharted areas, this new facility may well become as important to the development of aviation science as the 200-inch Palomar telescope is in the realm of astrophysics. Heart of the Laboratory is the unsurpassed equipment for testing full-scale compressors. C. W. LaPierre, Manager of G. E.'s Aircraft Gas Turbine Divisions, explains the reason for emphasizing research on compressors, stating, "We feel that the compressor offers the greatest opportunity for improvement in designing the turbine engines of tomorrow's planes because the compressor's performance, to a very large degree, determines the overall performance of the engine."

The facilities of the new Laboratory are engineered to conduct research on components, rather than complete engines, because of the company's belief that more fundamental design information can be obtained in far less time by this technique. Combustion chambers and turbines, as well as com-

General Electric's new multi-million dollar lab employs torture to unearth secrets from jet components

pressors, can be subjected to simulated flight conditions which have not heretofore been equalled in a test center.

In dedicating this newest tool of science to the memory of Dr. Moss, General Electric is paying tribute to the man who produced the turbosupercharger and who devoted most of his life to the development of the gas turbine. Dr. Moss built the first gas turbine in this country—perhaps in the world—in his last year of study at Cornell University. In the same year, 1903, Dr. Moss joined General Electric and began an illustrious career which earned him recognition as the outstanding scientist in the field of gas turbine research.

Because of General Electric's many years experience with gas turbines, the government selected the company to undertake the development and production of the first turbojet engine for the Air Force during World War II. At first glance, the close connection between the well-known turbosupercharger, proved in 1918, and the turbojet is not apparent. However, a second glimpse discloses that the turbosupercharger is actually "father" to the potent turbojet in the family of gas turbines.

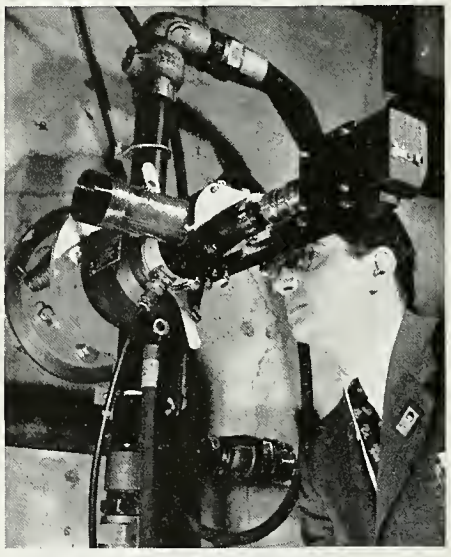
In a successful attempt to increase the performance of World War I aircraft at high altitudes, General Electric and Dr. Moss produced the first turbosupercharger. Their creation may be thought of as an "iron lung" which crams volumes of compressed air down the engine's "wind-pipe" to prevent it from "strangling" from lack of oxygen at rarified altitudes. Actually, it is a gas turbine-driven air pump which is powered by the hot exhaust gases escaping from the piston engine which it serves.

Similarly, the modern turbojet may be visioned as a powerful air pump which accelerates a jet stream of supersonic gases rearward to thrust the airplane forward in flight. It is also powered by the energy of flaming exhaust gases which are generated in integral combustion chambers. Encompassing many of the same type of components, the development of the turbosupercharger paved the way to the solution of some of the problems inherent in the creation of a successful turbojet.

Most impressive part of G. E.'s new laboratory is the 40-foot long, insulated and pressurized steel cylinder where full-scale turbojet compressors will give up their secrets to a score of test engineers. In this test chamber, altitudes of up to 70,000 feet and tem-

(Continued on page 17)

G-E executives C. W. LaPierre (left) and E. S. Thompson inspect scale model of an aircraft jet engine compressor.



With this water-cooled periscope it is possible to see the flaming combustion raging in a jet engine's exhaust pipe.

(Left) G-E test engineers peer intently at some of the 700 instruments which record every phase of gas turbine components' behavior under test. (Right) Control center from which the operations of the scale model compressor test stand are directed.

From this field at Fortaleza, Brazil, Missionary Robert R. Standley flies his Ryan Navion for varied purposes, ranging from emergency medical aid to transporting government officials. But primary use of plane is for his evangelistic activities.

SKY PILOT for BRAZIL

by Robert R. Standley, Director of Aviation, Equatorial Baptist Mission to Brazil, Southern Baptist Convention

THE work of God is being done with the help of wings in the wild, almost impenetrable jungle and desert country of Brazil. The wings are those of our trusted Ryan Navion, which has carried the gospel, and has gone on errands of mercy, to remote corners of our missionary field. This is in a far-flung area of northeastern Brazil, larger than the state of Texas and with virtually no roads or other means of direct transportation between settlements.

We have thanked the Lord hundreds of times for the Navion, which has been the means of evangelizing a vast region with few workers. During our first year of operation, from the time I arrived at my headquarters at Fortaleza February 10, 1950 with the brand new Navion, a total of 428 hours, 33 minutes were flown — a distance of approximately 52,000 miles, more than twice around the world at the equator.

STANDLEY

"Bob" Standley and his charming wife went to Brazil directly from a seminary 15 years ago. Working from Fortaleza he supervises an area larger than Texas. With courage and vision he is using the airplane to establish churches, schools and hospitals in his own province and in the remote jungle-bound villages.

At small Brazilian settlement, Standley is welcomed by police chief, mayor and mayor's son. On ground are turkey and 250 eggs presented him as gifts.

At first, it was believed that the Navion would be used to provide transportation for the evangelization of the immense regions in northeast Brazil, primarily in the State of Ceara, to which I was assigned. But, because of the lack of a resident missionary in the adjoining state of Piaui, I was appointed missionary in that field, and the area the Navion was to serve was automatically extended. Then, it was decided that since Maranhao is the neighboring state to Piaui, the Navion might provide transportation for field trips of the missionary of that state, also. In addition, surveys were made of the deep north-central region of Goias, in the very center of Brazil; and in the Sao Francisco river region of Baia, a coastal state south of Fortaleza.

In the Goias survey another missionary and I visited 20 cities in an area that had required my companion four

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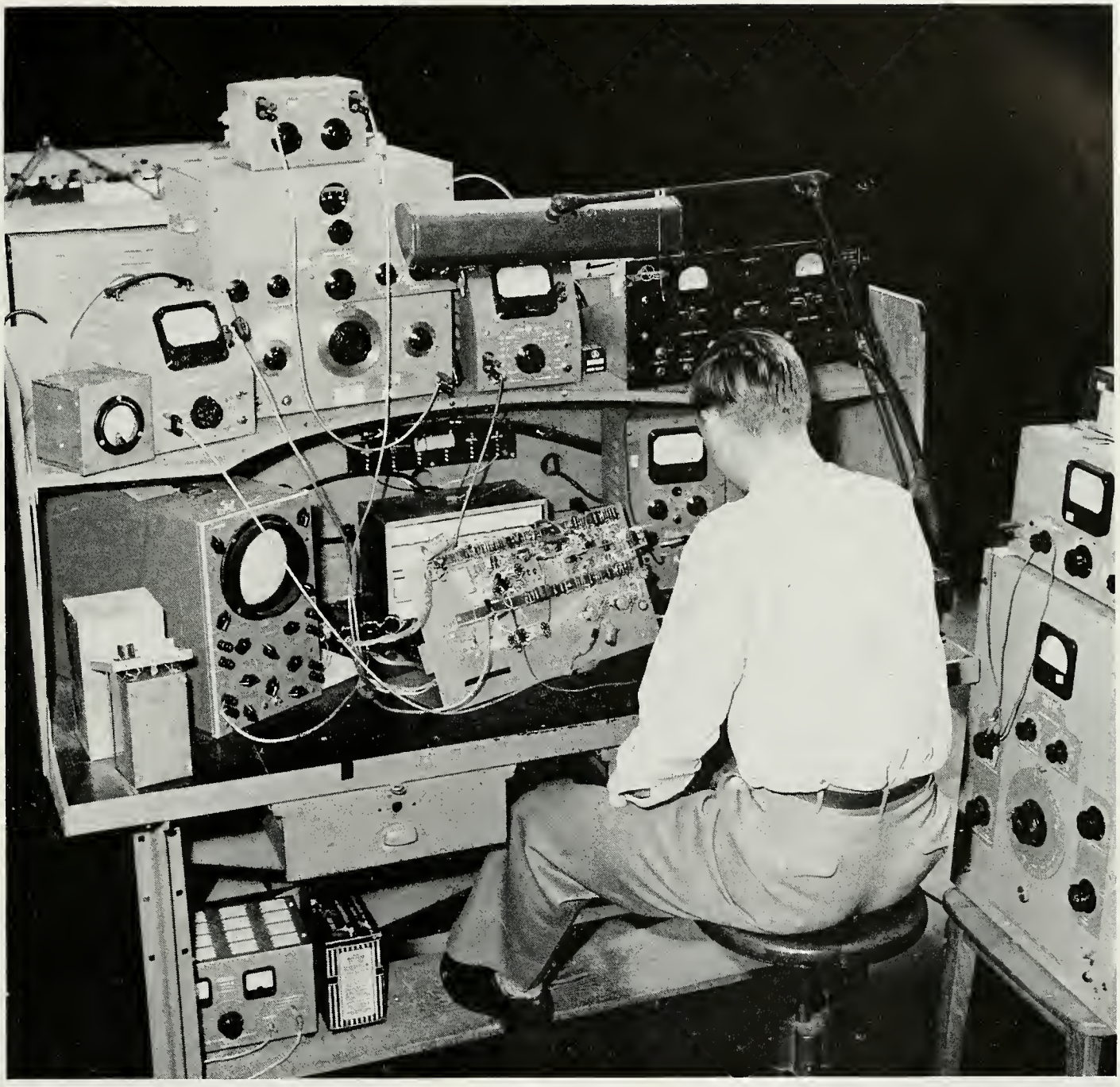

Surrounded by a maze of intricate equipment, T. C. Wells, Ryan electronics engineer, checks an experimental circuitry panel.

PACKAGED RADAR

FLYING radar stations for use in extremely advanced-type aircraft are being built experimentally at Ryan Aeronautical Company in "packages" so small they could almost fit into your brief case or handbag.

These new subminiature radar stations represent the ultimate in the years-long effort to shrink them to an absolute dimensional minimum. Huge radar installations with parabolic scanning units the size of a parachute canopy have been reduced in size to fit into a bulbous radome like that between the two fuselages of the F-82 Twin Mustang or enclosed in a Northrop F-61 Black Widow night fighter. Then such radar units were compacted into still smaller space, and compressed again and again to fit into packages of ever decreasing dimension.

In the latest Ryan unit, an electronic brain with the same uncanny, instantaneous information-gathering and transmitting ability of huge radar installations on ships and military bases ashore, has been crammed into an amazingly small space. Its only limitation is the range the information can travel. Otherwise, this creature of a modern-day Lilliputian world has all the potentialities of electronics giants.

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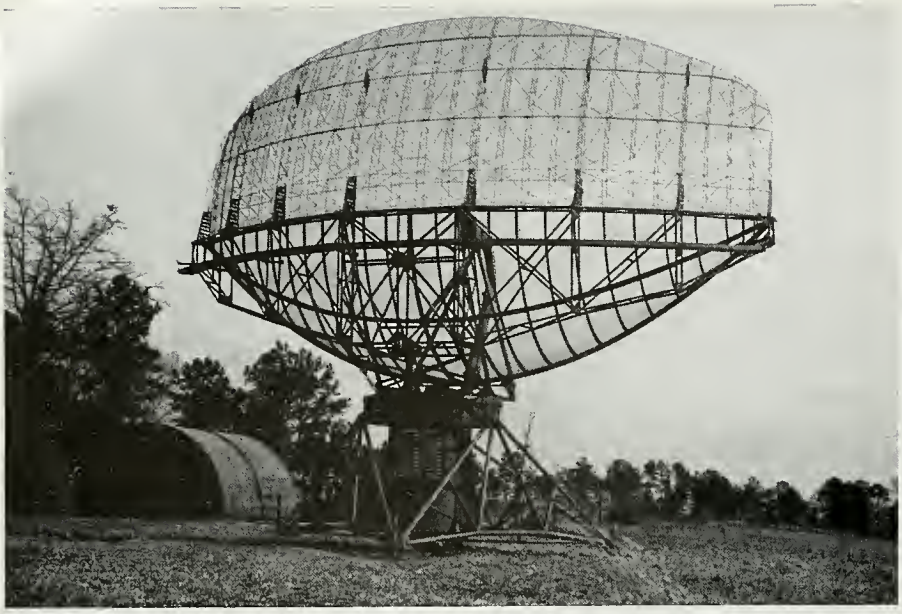


One of the great technical advances of World War II, early radar installations required huge parabolic scanners to transmit and receive "echoes" from targets.

To give fighters like this Northrop night and in overcast, radar "dish

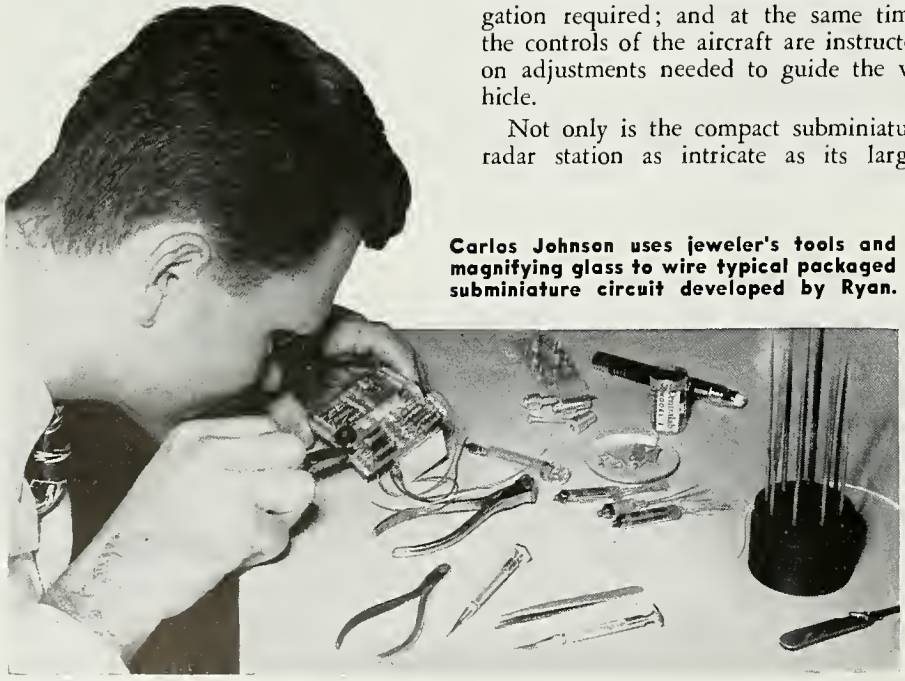
Tubes, resistors and coils no larger than a fingernail, a paper clip, or a key are packaged amidst an intricate maze of wiring, some strands as slender as 3/1000ths of an inch. The cylinder housing the brain is likely to be less than a foot in diameter and perhaps two feet long. Within the confines of that space, thousands of "messages" can pour in every second as the aircraft speeds through the thin upper air.

The flying radar station consists of an "intelligence" head, electronic circuitry, and a power supply section which provides the various voltages required.

The "brain" contains the transmitter and receiver. It transmits energy which, when reflected back, is received by a midget antenna equivalent to the "dish" style antenna of large radar installations. This data is supplied to the electronic circuitry, where it is amplified and "analyzed."

The information carried in the reflected energy, or "echo," is channeled to two places after it is extracted by the electronics circuitry. The "brain" is given the data it needs to determine the navigation required; and at the same time, the controls of the aircraft are instructed on adjustments needed to guide the vehicle.

Not only is the compact subminiature radar station as intricate as its larger



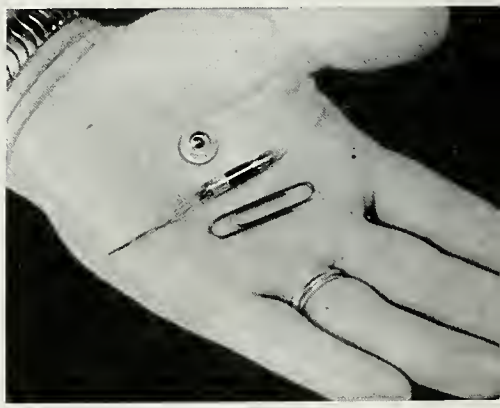
Carlos Johnson uses jeweler's tools and magnifying glass to wire typical packaged subminiature circuit developed by Ryan.

ELECTRONIC CONTRA

Broadening its activities in the ele velop a new type of equipment of an Aeronautics, T. Claude Ryan, president, the project.

While detailed information on th Director of Engineering, stated that it broad possibilities for further applicati

The development program is under engineer.

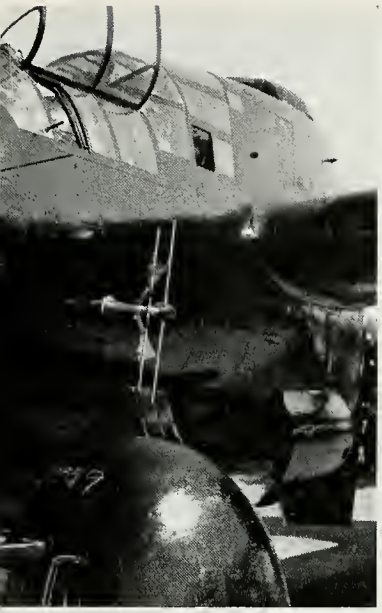


Thumb tack, paper clip give idea of compactn achieved in this miniature diode vacuum tu

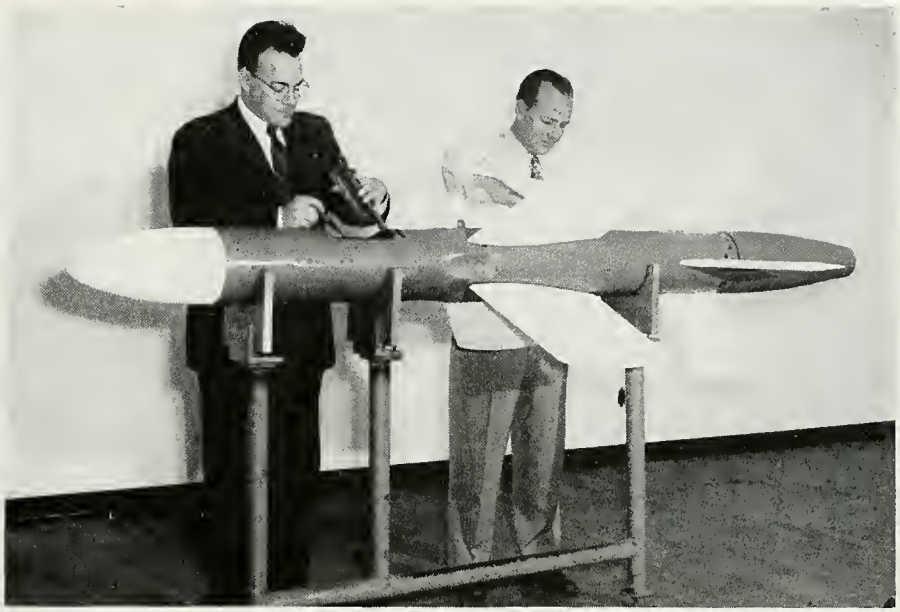
Subminiaturization

makes possibl

rada



Widow "eyes" to locate enemy at
compact to fit into nose of plane.



Ultimate in shrinking size of radar has been achieved in Ryan "Firebird" air-to-air guided missile, being examined by Owen S. Olds, left, project engineer.

VARDED BY U. S. NAVY

ld, Ryan Aeronautical Company will de-
nature for the U. S. Navy Bureau of
n announcing receipt of a contract for

ject is still classified, Bruce Smith, Ryan
company in a new field of work with

n of Owen S. Olds, electronics project

brothers on ships and ashore, or the "medium" sized ones in such planes as the Grumman Guardian, but it must be completely automatic in operation for space limitations do not permit an operator to be aboard the vehicle to supervise the functioning of the radar installation.

One of the major problems confronting engineers in designing a workable subminiature radar station and electronic brain is that of temperature control. It is important to maintain relatively stable temperatures to avoid changing its characteristics. Closely packed electronic tubes and their associated parts get extremely hot. Arrangement of heat-conducting chassis to reduce excessive temperatures to safe levels presents a major challenge. However, since the life of a subminiature radar station is short because of the nature of its mission, higher than normal temperatures can be tolerated for short intervals.

At high altitude the temperature problem changes. In this region it is extremely cold (—60° Fahrenheit). Thus, it might actually become necessary to introduce heat, such as through the use of heater strips similar to those in an electric toaster.

At high altitudes, pressure can reduce the effectiveness of insulation which is protected by air at lower altitude. To overcome this difficulty pressurization of the electronics packages may be required and can be achieved by enclosure in a cylinder containing air or an inert gas.

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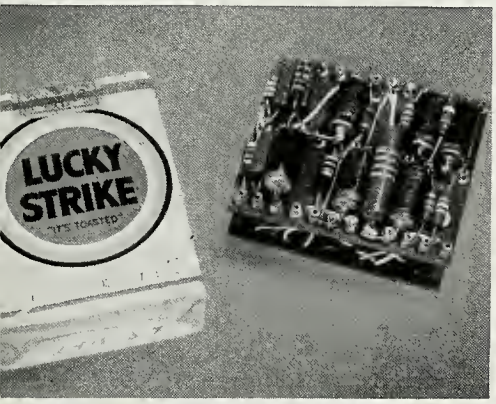


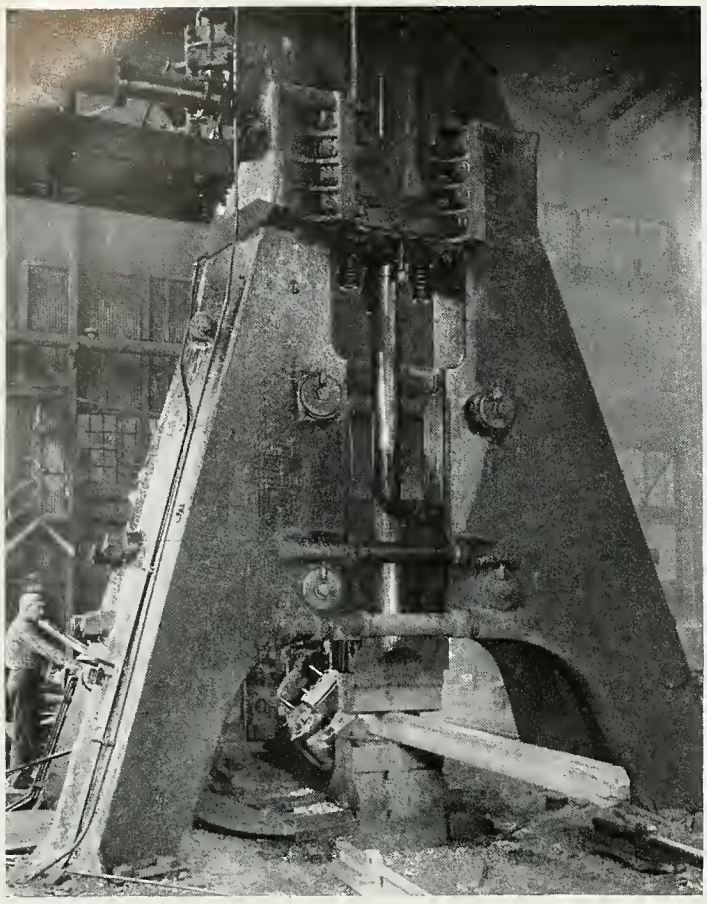
larger than a package of cigarettes is this
e-tube subminiature radar amplifier circuit.

ectronic components

iputian flying

tions

Adm. C. M. Bolster, Navy BuAer research director; Adm. G. B. H. Hall, guided missiles head; and Capt. J. N. Haley study Ryan developments in compact radar.



With mighty 8-ton blows, this thundering steam hammer forges 1½-ton Inconel ingots into blooms to make sheets.

A luminous sheet of cherry-red Inconel is removed from

NOBLE*

With the steady hum of a giant battery-charger, this electrolytic refinery captures pure nickel for use in INCO alloys.

Jet engine combustion chambers, made from flame-resistant Inconel, are given final approval by Ryan prior to shipment.

ling furnace to be rolled to size.

NICKEL

"a metal or alloy of... superior qualities, esp. resistance to corrosion." -- Webster

CORROSION resistance is a term that covers a lot of ground. At room temperatures, it means resistance to atmospheric corrosion. When conditions get really hot, as they do in jet engines and aircraft exhaust systems, it becomes a measure of how well a material resists the burning effects of hot gases blasting against its surface. That's why metallurgists specify Inconel nickel alloys for some of the most critical jobs in handling flaming exhaust gases.

Inconel, Inconel "X" and Inconel "W" are non-magnetic alloys which have been developed by the International Nickel Company after years of research and experimentation. These alloys contain roughly 75 percent nickel, 15 percent chromium, 7 percent iron, and a small percentage of other elements. They are designed to resist oxidation and to exhibit tough, unyielding strength over a wide range of temperatures.

Half a mile underground, this nickel miner chips out the vital ore which the great Sudbury Basin of Canada yields. Only a few pounds of the pure nickel are finally gleaned from each ton of ore.

For the walls of jet engine combustion chambers, such as Ryan builds for the General Electric J-47, Inconel is used to contain the volcanic explosions. These chambers are the "hot" heart of the jet engine, where a hurricane of air and flaming fuel are mixed together to generate the supersonic blast of exhaust which propels jet aircraft. Ordinary metals wilt under this destructive atmosphere, but Inconel is tailored to work in searing heat.

Good example of an application where Inconel X is superior, is this Ryan waste gate valve which diverts the flow of blazing exhaust gases to the turbosupercharger in the Boeing Stratofreighter.

The vital nickel which goes into INCO's special alloys comes from the great Sudbury Basin in Canada, one of nature's great storehouses of minerals. It is extracted from granite rock in deep mines more than a half mile underground. Then begins a painstakingly long process of sorting, crushing, grinding, and screening to separate the pinch of nickel from each ton of ore in which it is dissolved. Hot roasting furnaces burn off the sulphur and iron impurities in the ore and the remaining nickel and copper are separated in a huge battery-like electrolytic refinery. The nickel which accumulates on the shimmering cathodes of the tanks in this refinery is 99.9 percent pure and ready for melting into ingots.

The unusual qualities which make Inconel desirable for jet engine components—rugged strength, toughness and low creep rate under high stress and temperature—make it difficult to alloy and mill. It takes huge high-frequency induction furnaces, mysterious furnaces in which you could place your hand and feel little heat, to melt it down with precision and control. But metal in this high-frequency electrical field is immediately liquefied without evidence of flames or gases.

In the presence of high temperatures, Inconel alloys form a tightly adherent coat of oxide on their surface which protects them from corrosive attack. This characteristic is capitalized upon by Ryan designers in fabricating heat-critical jet engine components and complete exhaust systems for piston-engine aircraft such as the Douglas C-54 Skymaster. In the mill, however, this characteristic is bothersome because it requires that the ingots must be milled to remove the scale formed in the melting furnaces.

International Nickel mills Inconel alloys in their large plant at Huntington, West Virginia, which is unlike any rolling mill in the world. More than 40 INCO nickel alloys are produced here with special tempers, finishes and physical condition to meet the demands of 400 products. It is virtually a laboratory operation enlarged to production scale. When Ryan orders Inconel sheet and rod materials, INCO handles each order with special care to see that both Ryan and military specifications are met with regard to ingredients and physical properties of the metal.

A typically critical part which Ryan fabricates for an exacting job is the waste gate valve used in the main ex-

(Continued on page 23)

Time-Saving Timer

Employee team develops ingenious simplified control for welding machines

Proudly holding the new welding machine sequence timer which they designed and built, Eddie Duke (left) and Bill Phillips, of Electrical Maintenance compare its simple, compact design with the standard timing panel of a welding machine.

TWO Ryan employees have designed and built a better "brain" for spotwelding machines. Designated a sequence timing panel, this electronic device "tells" the spotwelder what to do and when to do it.

Tired of the tedious job of checking intricate circuits of standard sequence panels, when trouble occurred, Eddie Duke and Bill Phillips, of Electrical Maintenance, decided to do something about it. They worked out plans for the kind of compact, simple type of sequence panel which maintenance men would welcome—and built it. The new panel is performing so well that Ryan is installing it on all spotwelding machines for which it is adapted.

The Duke and Phillips panel is not only more efficient and trouble-free than those avaliable commercially, but it is much simpler to service and maintain. It is fabricated from a minimum number of readily obtainable parts which cost only a fraction of the price of panels which can be purchased. It is reducing to the absolute minimum the loss of valuable spotwelding machine time, due to sequence panel trouble.

With increasing tempo, the joining of aircraft structures is being accomplished by spotwelding because of the vast improvement in the equipment. Modern spotwelding machines, costing $30,000 each, can form strong joints in aluminum and stainless steel alloys at the rate of up to 125 spotwelds per minute. The successful performance of these giant tools is dependent upon the small electronic "brain", or sequence timing panel, which masterminds their work.

The timing panel automatically controls the exacting timing requirements for each phase of the sequence of spotwelding. "Squeeze" time, "weld" time, "hold" time and "off" time must be perfectly coordinated and timed to an accuracy of one-half cycle, or .0083 seconds, to obtain sound spotwelds. Consisting of a series of relays and electronic tubes, the sequence timer is put into action when the machine operator steps on a foot switch.

This action closes the first relay which actuates an air valve bringing the electrodes together under pressure and closing the second relay, which will time the "squeeze." As the second relay closes, it starts the welding current and trips the third relay which will time the current. Like a chain reaction, the third relay cuts the flow of current and actuates the fourth relay which will time the interval while the electrodes are held together to forge the material. The fourth relay also releases the air valve and trips the fifth relay which will measure the "off" time between the end of the operation and the next cycle. At the end of the "off" time, the first relay is automatically tripped and the cycle starts over again.

At a nominal rate of 70 spotwelds per minute, all of these precision timing operations must take place with 0.8 second for each spotweld. The hair-splitting of this 0.8 second into exact intervals for each phase of the spotwelding cycle is the important task of the sequence timing panel. During an eight hour day, it is possible to perform more than 30,000 spotwelds on a single machine. That is why Ryan electrical maintenance men are interested in two basic requirements for sequence timing panels: accuracy and ruggedness.

In developing a simpler panel, Duke and Phillips eliminated two complete relays and tubes from the standard type circuits and designed their new unit with six relays and four tubes. For compactness and convenience, they used midget-sized relays which are interchangeable and installed in 11-pin tube-type sockets. Although small in overall size, these relays actually have larger contacts than those used on standard relays. This permits them to carry more current and gives them longer service life.

(Continued on page 20)

Rolling Fortress

(Continued from page 1)

Continental AV1790 engine are lightweight power, dependability and ease of service. Long recognized as "musts" in flight operations, they are bringing new potency in the field to the General Patton tank.

Ryan's contribution to the unprecedented three-pounds-per horsepower weight ratio of the engine is the lightweight exhaust system. Fabricated from .050" gauge stainless steel sheet stock, these manifolds are patterned after aircraft exhaust systems and are in distinct contrast to the former heavy cast-metal exhausts used on tank engines.

The trouble-free service life experienced under extreme operating conditions with the first deliveries of Ryan manifolds has resulted in orders for large quantities of these components. Full scale production lines have been established to fabricate thousands of them with important new improvements being added.

Each manifold serves a bank of six cylinders, of the V-12 engine, with individual exhaust ports connecting with each cylinder. The entire system is compact in design and encompasses extremely sharp bends and short radii forming. The sheets of stainless steel are cut and formed with forming hammers in a series of three stages involving normalizing, de-zincing and degreasing between each forming. Rapid work-hardening of stainless necessitates that it be normalized at 1980° F. for approximately 5 to 10 minutes between each forming operation.

Emphasizing the exacting control required for production of this manifold is the fact that practically every type of welding process is brought into use in joining the metal of its component parts. The formed half-stampings are spot-tacked together with resistance type welding and carbon arc welding and the seams are welded with acetylene, atomic hydrogen or Heliarc inert gas. Outlet rings and port flanges are welded on with metallic arc and collars are attached with resistance type seam welding. The "hot spot" tube, which pipes hot gas from the manifold to heat the carburetor during extremely cold operations, is welded into the body with acetylene gas welding.

One of the heaviest punch press tasks is accomplished in blanking out the exhaust port flanges. A 65-ton blow cleanly cuts the flange out of 5/16" stainless steel and also knocks out four attaching bolt holes which are only .470" in diameter. Theoretically, this operation is not possible with the punch press because of the extremely small hole sizes in proportion to the thickness of the stainless steel sheets but it is being accomplished with clock-like regularity. Incidentally, the blanked out strips of heavy steel are welded together to form long-life pickling tank baskets—thus conserving every bit of this valuable material.

In the production assembly line, the tank engine manifolds are jigged with precision tools while the flanges, fittings and attachments are aligned. Flanges are

Acetylene gas is used to weld in tube which taps hot exhaust gases for carburetor heat in cold clime.

flattened in the punch presses after welding and then machined to fall within a plane which is .005" flat along the entire bank of six cylinders.

Stainless steel bellows are welded between each exhaust port section to provide a flexible connection which allows for heat expansion and contraction and to insure the water tightness of the tank engine. M-46 tank engines are now completely water-tight, permitting the engine to operate under water in fording deep streams.

QUICK replacement of Ryan tank engine exhaust systems in the field is possible with a minimum of skill. Two complete assemblies comprise one engine unit. These are removed and attached by setting four stud nuts which tightly hold each flange to the cylinder exhaust ports.

Ryan success in using ceramic coatings on exhaust manifolds for aircraft, such as the Boeing 377 Stratocruiser, has motivated Continental to request that these life-extending coatings be tried with the tank manifolds. Several sets have been ceramic coated and sent to Continental where they are undergoing tests to determine if the ceramic will give these components the same advantages imparted to the aviation-type systems.

Moss AGT Laboratory

(Continued from page 9)

peratures between minus 100° F. and 200° F. can be simulated. Experimental compressors are spun at thousands of revolutions per minute in especially dried atmosphere which is obtained by blasting air through "silica gel" dryers.

In the combustion chamber test stand, General Electric technicians can burn up to 50,000 pounds of fuel per hour and direct air pressure of 250 pounds per square inch into the flaming combustion chambers of future jet engines. To cool the exhaust from this test chamber, prior to releasing it to the outside air, it is passed through a water "bath", bringing the temperature down from 1800°F. to 400°F. The deafening roar of the explosive air blast is blanketed by a system of four huge maxim silencers which brake the velocity of the air and thus "drain off" its noise-making potential.

The all-important scientific information, which the elaborate test center is designed to divulge, is gathered from 700 different instruments housed in a sound-proofed control room. Here, expert observers record temperatures, air flows, air pressures, torque, blade strain, vibration and a host of other clues to the behavior of jet components under "torture-chamber" conditions.

The power requirements of the new laboratory are breath-taking in scope. General Electric constructed a complete power plant which delivers 255,000 pounds of steam per hour at 825°F. to drive the test equipment of the center. This 35,000 horsepower plant can drive the air compressors with sufficient force to supply air flows of 320 pounds per second. Such a compressor could completely change the air in a six-room house in two seconds.

More than 14,000,000 cubic feet of air an hour can be cooled to 100 degrees below zero F. through an ingenious cooling cycle which utilizes water from the adjacent Saugus river. In full operation, the laboratory requires 4,800,000 gallons of cooling water per hour.

No one can prophesy the trends in aviation progress which this new laboratory may initiate nor the power plants of the future which it may shape. If the past history of General Electric's efforts in research can be used as a guide to measure the success of this new facility, it will become another famous fountainhead of flight science.

Birth of an Airline

(Continued from page 7)

made possible by the fleet of "Ryan-Standards" and a Douglas Cloudster. But Ryan wanted a still higher performance plane which he felt would be suitable for the anticipated expanded airmail service the government was talking of turning over completely to private contractors.

So Ryan laid out the basic general design of the M-1, a high wing 3-place monoplane with 200 h.p. Wright J-4 Whirlwind engine, 800 pounds' payload, and 450 mile range. The goal was greater speed and more rugged, simpler construction than in the current biplane types used on government mail lines.

ANOTHER illustrious aviation pioneer figures in the story of the M-1. When the Los Angeles engineer hired by Ryan to perform the stress analysis failed to complete the job, Ryan went to his friend, Donald Douglas, and asked him to loan him his best engineer for part-time work in the evenings. That was how Jack Northrop, later the founder of Northrop Aircraft, Inc., got the job of completing the stress analysis on the Ryan M-1. Northrop, who remained on a part-time consulting basis for several years, performed engineering work on the Ryan Brougham, the first one of which was under construction when Lindbergh came along in 1927 and had a special version built to his specifications.

The first M-1 was being put together in the hangar at Ryan's airport on Dutch Flats, opposite the Marine Corps Base, when Gorst arrived in San Diego. Thereafter Gorst, Ryan and the M-1 became inseparable in the annals of Pacific Air Transport.

Ryan not only gave Gorst flight instructions, but helped him lay out the Los Angeles-Seattle route and prepare his proposal, which was accepted by the Post Office Department early in 1926. The strong competition that had apparently been shaping up faded away as difficulties of the operation were realized.

There was to be considerable night flying, with departure from Los Angeles at midnight to permit arrival in Seattle at 2 the next afternoon. Southbound the plane was to leave Seattle at 3:45 a.m., arriving in Los Angeles at 5 p.m.

It was almost like leaping into an abyss. Pacific Air Transport became the first privately operated line to be flown at night. There was no radio navigational assistance, and in the frequent fog and overcast the only aids were beacons that illuminated the Los Angeles-San Francisco and Portland-Seattle legs of the airway—the remainder being flown by day.

If the 25th anniversary of United Air Lines could be dedicated to any individuals, the honors fittingly would go to the daredevil pilots who gave their lives flying through darkness and foul weather which would even challenge modern airliners.

When Gorst had the contract in his pocket, he told Ryan he liked the M-1, wanted to order at least 6 planes, but needed more money.

Ryan recalls that when Gorst's fortunes were at a very gloomy low, a chauffeur-driven Pierce Arrow arrived one day at the dusty Angeles Mesa airport in Los Angeles where Ryan had just landed. An elderly man stepped out, introduced himself as C. N. Comstock, a retired Eastern banker, who sought further information on a newspaper item he had seen regarding a proposed airmail run to Seattle.

"This sounds like a good proposition to me," he remarked.

Ryan wouldn't let him out of his sight until he could introduce him to Gorst. Eventually, Comstock placed a substantial amount in Pacific Air Transport, enabling it to proceed. Later he became vice-president of the company.

The first Ryan monoplane, the M-1, was completed and passed its tests of speed, fuel consumption, rate of climb and cargo carrying ability (800 pounds of sandbags were used).

GORST decided that a survey flight over the Los Angeles-Seattle route was necessary to determine the time required on the itinerary outlined by the Post Office Department. This was to be an epochal venture.

Ryan piloted this first survey flight for Pacific Air Transport, carrying a token amount of mail between each town, where he and Gorst were royally welcomed by delegations headed by the postmasters themselves. Flight records were set between each stop—Bakersfield, Fresno, San Francisco, Medford, Portland and Seattle. The arrival of the M-1 in Seattle on March 18, 1926 was a great occasion.

The M-1 was living up to Ryan's belief that what this country's air mail lines needed was a monoplane of clean design to replace the awkward slow biplanes of the era. This commercial plane set a mark of 7 hours, 3 minutes, between San Francisco and Seattle, slashing by

(Continued on page 19)

South American Navion Distributor Visits Ryan

William Brotherton, Foreign Sales manager (l) talks with Luis Estrada, Ryan Navion distributor for Ecuador, during his recent visit.

LUIS ESTRADA, Manager of the firm of Compania Ecuatoriana De Aviacion, Ryan Navion Distributors for Ecuador, visited Ryan recently to arrange for shipments of Navion spare parts and inspect Ryan's manufacturing facilities. A member of one of the oldest and most prominent families in Guayaquil, Estrada pioneered in the development of private flying in Ecuador and organized his present company to handle Navion sales there.

During the past year Estrada's company has imported a number of Ryan Navions to Ecuador and has used five of them in the operation of a scheduled airline connecting the principal cities of Guayaquil and Quito with many of the smaller communities of the country. In this service ECUAVIA's Navions have operated from the Quito airport, which is over 9200 feet in elevation—one of the world's highest. With four persons aboard and full fuel tanks, Estrada reports their Navions climb at 300 feet per minute from Quito airport on flights in the mountainous Andes range. On some occasions, where baggage is light and flights short, five persons—four passengers and pilot—are carried in their Navion aircraft.

Interested in maintaining and servicing the Navions in Ecuador, until such time as world events permit the resumption of new Ryan Navion production, Estrada is arranging for continued parts shipments. He will visit other West Coast cities before returning to his home in Guayaquil.

almost an hour the record set the previous year from Seattle to San Francisco by an Army DeHavilland.

But other laurels were to be added by the M-1. On the return flight, the plane stopped over the weekend at Vancouver, Wash., while Gorst visited his family in Coos Bay. Ryan remained at Vancouver, and renewed acquaintances with some of the Army fliers he had known while in the service. Among these was Lt. Oakley Kelly, who had won fame for making the first non-stop transcontinental flight. At the Vancouver Army Base was Kelly's two-place, 400 h.p. DeHavilland, considered one of the fastest and most powerful in the Air Corps.

The Air Corps men looked with jaundiced eye on Ryan's M-1. Ryan's remark that it would fly 135 m.p.h. evoked considerable skepticism. When Kelly's DeHavilland attained that speed, the Air Corps had exhibited great pride. Flush with the triumphant receptions on the survey flight, Ryan confidently predicted he could beat the DeHavilland.

That was too much for the Air Corps men to swallow. They challenged him to make good his claim. A race was arranged, and duly publicized. Air Corps mechanics swarmed all over the DeHavilland the night before, tuning it up. Special fuel was poured into its tanks. Meanwhile, the M-1 sat to one side, forlorn and apparently neglected. Ryan had no mechanic and the only fuel he planned to use was ordinary automobile gas.

FROM Portland, just across the Columbia River, a huge throng surged into Vancouver to witness the race, which the newspapers had touted as one between the Army's pet plane and a small commercial craft being demonstrated for airmail use—400 h.p. versus 200 h.p.

Over a triangular course in which a column of the Interstate Bridge constituted one plyon and two other prominent points provided the other turning markers, the easily maneuverable M-1 sped past the DeHavilland to an astounding victory.

This event and the successful survey flight established the M-1 as America's new sensation in the air transport field. The first six were delivered to Pacific Air Transport, and used by that line and later by United Air Lines for years. Four other airlines ordered M-1's, as did numerous individuals. Expansion was necessary, and Ryan rented an abandoned fish cannery building to enter volume production.

Thus was Ryan established as an airplane manufacturer.

For good reason, the 25th anniversary of the Pacific Coast route of United Air Lines holds an especially warm spot in the heart of T. Claude Ryan, aviation pioneer.

The Ryan link with United has continued through the years. Today, United's giant Douglas DC-6B's, DC-6's, and Boeing Stratocruisers as well as DC-4's and DC-3's are powered with engines whose exhaust systems are manufactured by Ryan.

Packaged Radar

(Continued from page 13)

Vibration and shock also create problems difficult of solution. Although the subminiature radar station is composed of very rugged components, the severe vibration and shock to which the system is subjected necessitates the addition of carefully designed and located shock mounts and vibration dampers.

In the procedure of subminiaturization, the electronic designer often begins with standard size parts to establish the values of the components and to prove the "paper" design. Then the parts are reduced to subminiature size, and are placed on an experimental panel known to the engineers as a "breadboard." The parts are comparatively widely spaced to make the unit easily accessible for adjustment and change. Then the parts are gathered together on a circuit panel to establish their overall functioning ability before the required degree of compactness is achieved.

Now comes the arduous period of testing for practicability. Not only must the electronic brain occupy a minimum space to perform its intelligence mission, but it must be rugged, adequately cooled (or heated, as the case may be), accessible to work on, and suitable for large scale production. It must "think" without hesitation and with pinpoint accuracy while traveling at tremendous speeds and, above all, it must be reliable. Individual items of equipment must exceed the reliability factor of the total assembly by a wide margin.

Development of subminiature radar systems by Ryan Aeronautical Company has been a logical outgrowth of research work on its rocket-propelled "Firebird" air-to-air guided missile and other projects.

NEW NAVY REPRESENTATIVE—Comdr. Cedric W. Stirling, second from left, on first visit to Ryan plant views secret Navy research project. With him, left to right, Bruce Smith, Ryan director of engineering; Lt. Al Hudgins, Navy engineering officer under Stirling; Benjamin Grondona, Navy civilian engineer; and Robert Shover, Ryan project engineer.

New Navy Representative for San Diego

Comdr. Cedric Warren Stirling is the new Navy Bureau of Aeronautics representative for the San Diego area, succeeding Capt. Freeman Cutter, who was stationed here for 15 months.

Stirling previously was in charge of the aerodynamics laboratory at the David Taylor Model Basin, Carderock, Md., where he performed wind tunnel research and development testing on Navy aircraft models. He will oversee Navy projects at Ryan and other aircraft plants in this area.

Cutter has been transferred to the Armed Forces' Industrial College in Washington, D.C.

CERAMICS CHECK—General Electric Co. design engineers Hevener and Dodge, first two at left, inspect ceramic-coated exhaust system parts with Ryan service manager Foushee and Hugh V. Penton, extreme right.

Ryan Ceramics Attract General Electric Engineers

Substitution of non-strategic materials in vital portions of the General Electric J-47 jet engine, the top production engine for the Air Force, can be made with no sacrifice in performance, G. E. engineers visiting Ryan Aeronautical Company revealed recently.

They conferred with Ryan officials at San Diego regarding the desirability of applying ceramic coatings to such materials to increase their performance life—a principle already proved by Ryan in piston-engine exhaust systems.

Inconel, high in content of nickel, and other critical alloys, can be replaced by less strategic alloys in such parts as the jet engine's inner combustion chambers and transition liners, already being produced by Ryan, the G. E. engineers were informed. R. W. Hevener and Wallace R. Dodge, design engineers at G. E.'s Lockland, Ohio, plant, have been studying Ryan's production experience in ceramic coating with the view to adapting it to the non-strategic materials.

Being considered is application of a U. S. Bureau of Standards ceramic coating with which Ryan has the only production experience in the aircraft industry, according to C. L. Foushee, Jr., Ryan service manager who conferred with Hevener and Dodge.

Ryan already is producing ceramic-coated exhaust system parts for hundreds of engine sets on such planes as Boeing Stratocruisers, Convair Model 240 and 340 Airliners, Boeing B-50 bombers and C-97 Stratofreighters, and on the General Patton tanks.

TALK OF THE COUNTRY—Ceramic coating was the topic at this conference between G-E and Ryan officials. L. to R.: Ralph Haver, metal products design specialist; Richard Offenberg, Ryan field representative at Dayton; W. R. Dodge of G-E; Richard W. Hevener, G-E; Hugh V. Penton of California Metal Enameling Co.; Wilson G. Hubbell, chief metallurgist; C. L. Foushee, Jr., Ryan service manager; John Hayes, G-E resident representative in San Diego; Fred Coffer, customer service coordinator; A. S. Billings, chief inspector at Ryan and (back to camera) Henry Berlinghof, Ryan service representative.

Time-Saving Timer

(Continued from page 16)

An important advantage of the new sequence timer is the fact that it can be used on any resistance spotwelder of single phase or stored energy type by simply installing or removing a jumper wire. With this facility, it is possible to standardize on one uniform type of panel for most machines. Electrical maintenance men can learn the circuits of this panel and be familiar with it when trouble arises without being faced with the task of trying to figure out several different types of panels which are installed on various machines. It is not unusual to find a valuable spotwelding machine tied up for 48 hours while sequence panel wiring layouts are checked for trouble.

With the new standardized sequence panel, there is no need for taking a machine out of production for more than a few minutes because of timing panel trouble. Electrical maintenance simply removes the defective timer and installs another sound one which they have ready as a spare. This is readily accomplished because these panels are fitted with plug-in connection wiring and the procedure is tantamount to plugging an ordinary clock into a convenient outlet. Then, the faulty sequence timer may be taken to the shop and worked over at leisure.

Another benefit gained with the newly designed sequence panel is the elimination of imperfect spotwelding due to operator error. With standard panels, it is possible for the operator to release the foot switch prematurely before the welding current has been cut and bring the forging pressure to bear during part of the weld time. This excess pressure prevents the formation of the spotweld. With the new panel it is not possible for the operator to commit this error because the circuits are so designed that the operator cannot alter the perfect, automatic behavior of the sequence timing after the cycle has been started. Each relay locks itself in and cannot be prematurely released because of operator error.

The success of this new device is a graphic illustration of the value of giving thought to the job to be done and wanting to improve it. It also points up the advantages which the man on the job has, in understanding the fundamental needs of the work and equipment, over the more remotely located engineer who will not personally use the equipment. In truly American style, Eddie Duke and Bill Phillips saw a need and used their thought and energy to supply a practical solution.

Sky Beams

(Continued from page 5)

tem problem for the Plant Engineering department.

D. H. Palmer, Ryan Plant Engineer, and his staff met the problem head-on by designing and installing a quick conveyor system of unusual features. It slowly removes the baskets of hot parts from the molten salt, speeds them to the quench tank and gently lowers them into the water—all in less than 10 seconds. Care in removal and insertion is required because the parts are soft and subject to warpage at high temperatures.

The system is motivated by continuous roller chains which are driven by a special variable speed, wound-rotor electric motor. The operator, behind a glass enclosure, moves a switch controller which selects the motor speeds desired. Ryan-designed dampeners prevent swaying of the rapidly-traveling baskets. The motor is equipped with a brake for sudden stopping. After quenching, the beam components are prepared for spotwelding.

Painstaking care is used in cleaning all beams prior to spotwelding. They are immersed in an alkali bath and rinsed in hot water to remove soil. Then they are washed in an etchant bath of hydrofluosilicic acid to remove surface oxides. These oxides would increase surface electrical resistance and Ryan specifications require that surface resistance be kept below 50 microhms. Spotwelding must be performed within 8 hours after cleaning to maintain this standard of quality.

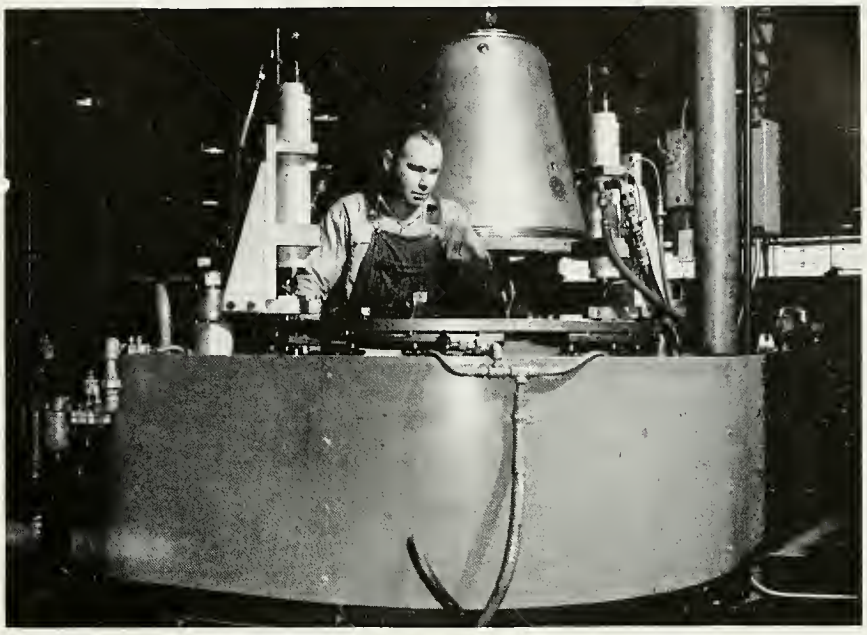
EVEN one small particle of foreign matter can ruin a spotweld by causing an explosion of the metal. The foreign material increases the electrical resistance causing an accumulation of heat which melts out the metal in an explosive reaction.

The battery of spotwelding machines which Ryan employs to build the floor beams are the largest condenser-discharge type available. They have capacities of 2,600 microfarads and can be charged to 3,000 volts. Each spotweld is precisely located on .75″ centers lengthwise and .50″ across the beam by means of a locating focused light. Machine performance is checked hourly by test samples and a daily X-ray analysis of the spotwelds is made to guarantee the high strength required.

The spotwelding technique saves substantial amounts of time in production and some weight. However, it must be performed with the best equipment and care because unlike rivets, which can be replaced if defectively installed, spotwelds cannot be replaced or improved when once made. If a machine were to produce a number of defective spotwelds in an assembly, it would require that the whole assembly be scrapped because of this phenomenon.

The C-97 floor beams are critical in dimension in beam width and in the size and location of the attachment bolt holes. After being spotwelded together, the beams must be precisely trimmed with a rotary, air-driven saw to within .002″ width. The attachment bolt holes are then drilled and located to a tolerance of .002″ also. Finally, the entire beam is hand-straightened so that it is within .030″ straight for its entire length. These operations require a goodly amount of care because 24 of the 49 beams for each Stratofreighter are of different dimensions in order to conform to the varying measurements of the fuselage.

Ryan installs four of the completed floor beams in each of the aft sections of the fuselage which is fabricated at Ryan, and ships the remaining 45 beams to Boeing for installation in the other fuselage sections.



Automatic Tool Speeds Production

PRECISION drilling of the 160 bolt holes in the flanges of the General Electric J-47 jet engine exhaust cones is accomplished in a fraction of the time otherwise required by means of several Ryan-built drill jigs now in use. Designed and built by the Ryan plant engineering department, these accurate tools drill the bolt holes in the cone assemblies in just 80 minutes.

Each drill jig consists of a precision-made steel tool which rigidly holds the General Electric component while a pair of Keller Airfeedrills cut through the one-half inch stainless steel flange. After the cone assembly is locked in the jig, the drills are pivoted into position in such a way that their cutting bits are exactly located as required by engineering specifications. The hole pattern for these bolts must be accurate within ten thousandths of an inch, radially. Hole size tolerance is plus .004″ and minus .001″.

A single valve is pressed by the operator to drive the drills which are powered by a pneumatic blast that actuates the pistons in the drills. Drills start simultaneously, cut through the tough metal and return to their starting position without supervision. The automatic return is individually controlled by special pre-set air valves which go into action when the drill bits have penetrated to the required depth.

A water soluble lubricant is sprayed on the cutting area, by a motor-driven pump, to carry away the heat generated by friction of the drills. The entire drill jig is immersed in a steel tank which collects the lubricant and circulates it through the system.

After drilling, the jet assemblies are removed and placed in a Ryan-built deburring machine which carefully removes the burrs of metal caused by the drills, without undercutting the flange itself.

Service Tested Ceramics

(Continued from page 3)

headers which were coated on the interior only, a reduction of .003" was found to have occurred on the exterior surface as a result of high temperature scaling.

A photomicrograph, Figure 1, taken at the hottest zone (interior) of the header coated on both sides, shows a definite white area lying immediately under the surface of the ceramic material, which has been decarburized. This loss of carbon, which is an associated phenomenon with the use of the ceramic material at elevated temperature, is an advantageous development because it reduces the chance of surface embrittlement or loss of ductility.

It was necessary to determine that the white zone was caused by decarburization rather than by absorption of some constituent of the ceramic coating because in the case of the latter circumstance, the metal would have become harder and undesirably more brittle. This had to be watched because the ceramic material contains silicons which could conceivably work as efficiently to harden the stainless steel manifolds as they do when used for hardening tool steels—if they were absorbed in appreciable quantities.

Microhardness tests were made of this white area, indicating that the zone was not hardened and that it was decarburized. Photomicrograph Figure 2 shows the surface of this header, which was polished to determine the hardness of light etching zone at the surface. The hardness impress represents an actual depth of about .0005" below the surface and gave hardness readings of 20.5 Rockwell C. at the surface with an average interior hardness of 25.0 Rockwell C.

Also shown in Figure 1 is the evidence of small quantities of carbide. This amount and distribution is normal with this material as it comes from the steel mill and has not been caused by service conditions. From this photomicrograph it can be seen that the ceramic coatings have protected the surfaces. The interior of this header was very smooth. The natural green color of the ceramic coating had changed to black in appearance. A sample of this black coating, when subjected to spectrographic analysis, indicated that it contained the same ingredients as the original green coating—showing that the ceramic material had not been removed but merely altered in appearance.

The Figure 3 photomicrograph was taken of a header which was not coated with ceramic material but which was made from the same metal as that used with the coated headers. In this control header, a typical "salt and pepper" structure of carbide formation can be observed. This amount and distribution is substantially greater than normally found in the new metal. It indicates that the elevated temperatures have caused carbon to be absorbed from the exhaust gases and precipitated within the grain structure of the metal.

THIS photomicrograph shows the formation of some oxide solution at the surface of the metal and a moderate build up on the surface. These oxides have penetrated into the metal, entering at the grain boundaries.

In photomicrograph Figure 4 we see an advanced condition of intergrannular corrosion or a separation of the grains of metal by corrosion. This header was fabricated from another metal which does not have the ability to withstand the high temperatures at which this part must operate. There is a heavy carbide precipitation and carbon absorption in evidence, which preceded and prepared the way for the intergrannular corrosion. Oxide solution has also taken place.

Oxidation and carbide precipitation lead to rapid deterioration during service life under the conditions peculiar to this application. It is seldom that intergrannular corrosion is observed in materials designed for conducting gases at high temperatures. Most materials, even though they contain high percentages of unstabilized carbon, develop a tightly adherent film which excludes the product causing corrosion. In this case, however, the material developed a loose scale which did not prevent continued attack by corrosive media.

Observation and experience in the Ryan Development Laboratories have shown that much of the deterioration of unprotected headers has been due to the high rates of carbon absorption with resultant surface embrittlement. The ceramic coating prevents this carbon absorption, eliminates oxidation and inhibits corrosion attack—thus greatly extending the service life of such component parts.

To test the thermal shock characteristics of the ceramic coatings, the Ryan Laboratories conducted a series of tests in which coated headers were heated to 1700°F. and quickly cooled to -70°F. Handling time was kept to 10 seconds. Specimens from each run were dropped six feet to a concrete floor to check for hot and cold impact results.

After all test runs there were no cracks, chips or other damage to the ceramic coatings. This is an important advantage in this application because such durability makes it possible to align the exhaust sections in precision jigs with torches and rubber mallets without chipping or crazing the ceramic coatings.

Ryan is the only aircraft company in the nation providing ceramic coated parts for aircraft use on a production basis.

(Continued on page 23)

Aircraft Heads Meet at Boeing

AVIATION LEADERS—Seven of the top executives of the West Coast aviation industry are pictured above with their host, William M. Allen (seated), president of Boeing Airplane Company, during a recent Seattle meeting of the Aircraft Manufacturers Council.

Standing, left to right, are J. H. Kindelberger, chairman of the board of North American Aviation; LaMotte T. Cohu, president of Consolidated-Vultee; Robert E. Gross, president of Lockheed Aircraft Corp.; F. W. Conant, senior vice-president of Douglas Aircraft Company; T. Claude Ryan, president of Ryan Aeronautical Company; Oliver P. Echols, chairman of the board of Northrop Aircraft, Inc., and Rear Admiral DeWitt C. Ramsey, USN (ret.), president of the Aircraft Industries Assn., of Washington, D.C. —*Boeing Photo.*

The entire fleet of Boeing 377 Stratocruisers is being re-equipped with ceramic coated headers as replacements are made as a result of the tests conducted by Ryan. These giant airliners are in the services of Pan American World Airways, Northwest Airlines, United Air Lines, British Overseas Airways and the Military Air Transport Service.

PRODUCTION orders for ceramic coated exhaust system components have also been received from Convair for the fleets of 240 airliners operated by American Airlines, Pan American and Western Air Lines as well as Continental, Northeast and Midcontinent. Similar ceramic coated siamese exhausts are on order for the new Convair Model 340 transport. Experimental orders have been received from Pratt and Whitney for fully ceramic coated manifolds for their latest series R-4360 engines which are used on the Boeing C-97 and B-50 aircraft and the Convair B-36 intercontinental bomber.

Experimental work is also being conducted with Douglas Aircraft Company and United Air Lines on ceramic coating of DC-6 transport exhaust assemblies through service tests on actual scheduled runs.

And on the ground, Continental Motors Corporation's 825 h.p. engine for the General Patton tank will have ceramic coated sections on the manifolds due to go into production soon at Ryan.

Ryan's pioneering work with ceramic coated exhaust systems goes back to World War II when comprehensive studies were made by the laboratory to conserve vitally needed chromium and nickel supplies. From these investigations, a suitable ceramic coating was developed and applied to mild steel exhaust systems which were fabricated for 500 Douglas A-20 attack bombers. This alleviated the shortage of stainless steels and their critical ingredients. With horsepower rating zooming, Ryan is again employing ceramic research to find the means of meeting high temperature requirements for jet and piston engine uses.

—William P. Brotherton.

Construction of Atomic Energy Commission's new ore refining plant at Fernald, Ohio is speeded by unique 15-mile "airline" operated by Ryan Navion Super 260.

8 MINUTE AIRLINE

A private airline route only 15 miles long, which is flown in a mere 8 minutes, may not sound like a very practical operation for a modern business plane, but it's proving a tremendous advantage in the construction of the Atomic Energy Commission's ore refining plant being built at Fernald, Ohio.

Operated by Construction Service, Inc., earth moving and erection equipment rental firm of Ludlow, Kentucky, a Ryan Navion Super 260 flies vital repair parts from Greater Cincinnati Airport right to the side of disabled equipment at the construction site, where a 1500-foot landing strip has been scraped.

"A truck requires nearly two hours to perform the same service," says William E. Ward, president of Construction Service, Inc. By car or truck it is a very long, hot, dusty, tiresome trip. By air it's a brief eight minutes, vaulting over surface traffic and difficult, often congested driving conditions.

Whenever a vital part is needed on any of the $500,000 worth of huge grading and earth moving machines being used at the job, it is flown directly to the Fernald area strip by Charles Kittle, company pilot who flew bombers in World War II.

In addition to use for the aerial repair service to keep vital grading equipment "on the job," Construction Service has made the Navion available to Atomic Energy Commission officials for emergency use. Not only does the Navion operate on the short 8-minute route to the construction site, bu it is always available for emergency flights to distant cities to pick up hard-to-get parts. Kittle has made emergency flights to Charleston, West Virginia; Louisville; Bay City, Michigan; and Cedar Rapids, Iowa.

Noble Nickel

(Continued from page 15)

haust duct of the Boeing C-97 Stratofreighter aircraft exhaust system. This is a large butterfly-type of valve which is operated to divert the flow of hot exhaust gases to the turbosupercharger, or "iron lung" of the engine. The valve must open and close smoothly in a blast of 1900° F. gas which is exerting 30 pounds per square inch pressure on the system. It must fit snugly against the circular walls of the exhaust duct with its edges meeting the duct at an angle of 15 degrees. It must be free from scaling at high temperatures and have a low coefficient of expansion so that it will not seize or warp. It is precisely machined within tolerances of .005".

Ryan metallurgists advocate Inconel "X" as the material for these critical waste gate valves because of its high strength and good properties at elevated temperatures. To achieve these properties at high temperatures, Ryan ages the waste gate valves in an oven at 1300° F. for 20 hours. The ability of Inconel "X" to attain its ultimate strength through heat treatment provides uniformity of properties whereas cold working, required to harden many austenitic alloys, tends to harden the surface of the material with less effect toward the center section.

AT Huntington, West Virginia, the making of Inconel sheets is a thundering, violent task of hammering heavy ingots with 8-ton forging hammers and squeezing hot billets between smooth, hard steel rollers like pie crust. The final sheets emerge from massive sheet mills which exert so much pressure that a tiny particle of grit on the sheet could ruin both sheet and expensive rolls. To prevent this, the strip mill is kept meticulously clean and the Inconel strip is continuously washed with oil and rubbed dry with felt wipers as it weaves between mills.

By the time the lustrous, flat sheets of Inconel alloy arrive at Ryan, each sheet contains just about the amount of alloy which a half-ton of original ore has yielded. Into these few pounds has gone all of the finest skill and research which metallurgy can produce.

Douglas Officials Get Data On Ryan Project

DOUGLAS, RYAN OFFICIALS CONFER—Information on an advanced Ryan exhaust system research project was provided recently to Douglas Aircraft Co. engineers by Ryan representatives. Left to right, Henry Berlinghof, Ryan field service engineer; W. F. Walker, Douglas Long Beach air conditioning project engineer; J. W. Stanford, Douglas Santa Monica flight test engineer; Phil Compton, Douglas Long Beach assistant power plant staff engineer; Bill Bunsen, Ryan assistant project engineer; and Cliff Starr, Douglas Long Beach power plant staff engineer. The visiting group flew here in a Douglas-owned Ryan Navion. 37 96

Sky Pilot of Brazil

(Continued from page 10)

months to travel by mule train and truck some time before. It took us only four days by Navion to accomplish as much, if not more.

To many Brazilians, our Navion has come to be known as a great bird of mercy. When the Jaquaribe River flooded the city of Aracati in May, 1950, we made several flights transporting doctors, nurses and government officials to the stricken area.

A man who had contracted tetanus in the interior of Brazil was flown by our Navion to Fortaleza for medical attention. The body of an old lady was taken to her home town in the interior of the state for burial, and the body of a young man killed in an automobile accident was brought from Salvador, Baia, to Fortaleza for burial. (In the latter case, a commercial airline asked $2,000 to transport the body. (I did it for the expenses of the trip, $100.)

The Navion has been used to fly an engine and other replacement parts, and mechanics inland to repair planes which had been stranded for months because of difficulty in reaching them. It was employed by the American consul at Fortaleza to investigate the destruction of American property in a case of religious persecution in the south of Ceara; and it helped in the search for a wrecked B-25 from the Fortaleza Air Base.

But its primary use is in the field of evangelism. Under the old system, churches in my field could not be reached more than 2 or 3 times a year. Within a one-year period, I was able to visit these same churches 25 times and more. I feel sure that this newfound mobility of the flying missionary has made possible the healthy state of the field at this time. Regions in the interior we could not reach previously are now scenes of regular preaching services. Even along the coast, many communities are almost inaccessible because of lack of roads. A trip that would require four days by canoe and horseback can be negotiated in 40 minutes by Navion.

Because our funds are limited, we kept a close watch on expenses of operating the Navion. During that first year, gas, oil, hangar, service fees and parts, costs proved a startling and pleasant discovery. Cost per mile was 5 cents, but still more gratifying was the cost per passenger mile, since we rarely made a trip without one or more passengers. This came to only $.012. Even adding the cost of taxi service from city-to-field, and field-to-city, and miscellaneous expenses, such as telegrams regarding plane trips, hotel bills, etc., the costs were still only $.063 per flight mile and $.016 per passenger mile, an amazing demonstration of economy.

After a year's service, the Navion was in perfect condition. When time came for the 500 hour overhaul, I did it myself, assisted by an excellent mechanic, a missionary from another mission in the interior of Ceara, the state of which Fortaleza is capital. I was also able to perform almost all the other mechanical maintenance, and Ryan Aeronautical Company has kept me supplied with parts shipped from San Diego. Thus, the cost of maintenance has been held low.

In my financial report to the mission headquarters on use of the Navion, I pointed out that after one year, its value in the Brazilian market, plus the value of parts and tools in stock, equaled $10,900.

"When one considers that the Navion cost, with the parts bought at the factory, $11,800, we come to the conclusion that the Navion has been an unusually good investment of missionary money," I wrote.

But dollars and cents don't tell the story of the real value of the Navion as an instrument of Christianity.

Often as we fly we look down on vast forests where Indians still roam, and notice a lonely trail or winding river, the only link between almost isolated settlements. We realize then that we never could have hoped to bring God's message to the hinterland except by means of the Navion. It is the 20th century missionary's indispensable partner in penetrating hitherto impassable frontiers.

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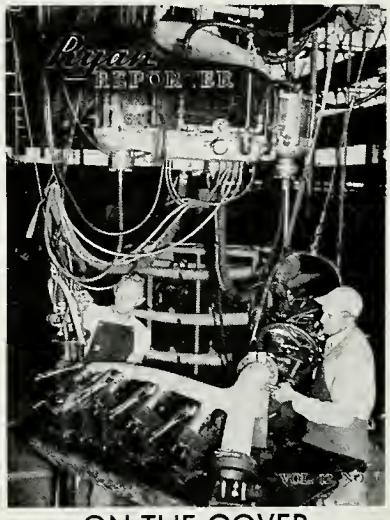
Robert F. Smith, Navion news editor
Don Doerr, chief photographer
William Wagner, editorial director

→

New, twin spotwelding guns, suspended from monorails, are used by Kenneth Fishel (left) and Frank Marsh in the Wasp Major exhaust system assembly.



ON THE COVER

The Once Over by H.I. Phillips

A writer for The Associated Newspapers, Hi Phillips' column appears in the New York World-Telegram and other leading newspapers. He's been called "the average citizen expressing himself with gusto and point and great common sense on a wide variety of subjects."

IF WRIGHT TRIED IT TODAY

87 96

"For some years," wrote Wilbur Wright in a letter back in 1900, reproduced in the new book, 'Miracle at Kitty Hawk,' "I have been afflicted with the belief that man can fly. My disease has increased in severity and I feel that it will soon cost me an increased amount of money, if not my life. I am trying to arrange my affairs so that I can devote my entire time to the job."

Wilbur and Orville were then owners of a little bicycle shop, making a meager living. We can't help imagining what would happen today in the era of nonrugged endeavor and "let-Washington-take-care-of-everything" philosophy, if there were no airplane and a businessman invented one. It seems to us the story would run like this:

1. Bicycle shop owner has idea for a plane to revolutionize transportation. He is so busy filling out sales tax records, Federal forms, affidavits, etc., that he has little time to devote to it.

2. Ultimately draws blueprints and wonders what to do next. Rejects idea that he could possibly succeed on his own through persistent courage and self-denial.

3. Writes to Washington lending agencies explaining that he thinks he has a machine in which man could fly. This brings an FBI agent to his house in belief he is nuts.

4. Establishes sanity by showing registration as a Democrat. Writes a bureau giving complete details of airplane.

5. Receives a reply beginning, "In reply to your letter regarding the invention of a plastic fishing rod."

6. Sends a second letter enclosing blueprints. Reply comes "thanking you for your offer of hatch covers for naval ships at $18.25 each."

7. Gives up trying to get anywhere by correspondence and goes to Washington. Finds he must contact a five per center, cut him in on the idea and give him a free plane.

8. Spends a year trying to find right office, even with help of five per center.

9. Finally, through Federal loans, builds plane and announces tests at Kitty Hawk.

10. Government names committee to see tests but sends it to Pueblo, Colo., by mistake.

11. A committee shows up two years later to see the plane fly at Kitty Hawk, but it develops that it was a committee supposed to have been sent to New Orleans, La., to watch a demonstration of an electric railroad switch.

12. Inventor names date for a new test. Strikes prevent necessary work on plane. Matter goes to a Federal mediation board.

13. Inventor, now weary and bent, decides to forget the whole thing and go back to his bicycle store.

14. Finds bicycle business failed long ago, due to taxes.

15. Decides to take a job on Federal payroll and get along without any troubles to speak of.

RYAN AERONAUTICAL COMPANY
P. O. BOX 311
SAN DIEGO 12, CALIFORNIA

Form 3547 requested

RYAN
Answers
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Leading stainless steel fabricator for the aircraft and aircraft engine industries

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JET ENGINE COMPONENTS

EXHAUST SYSTEMS

ROCKET ASSEMBLIES

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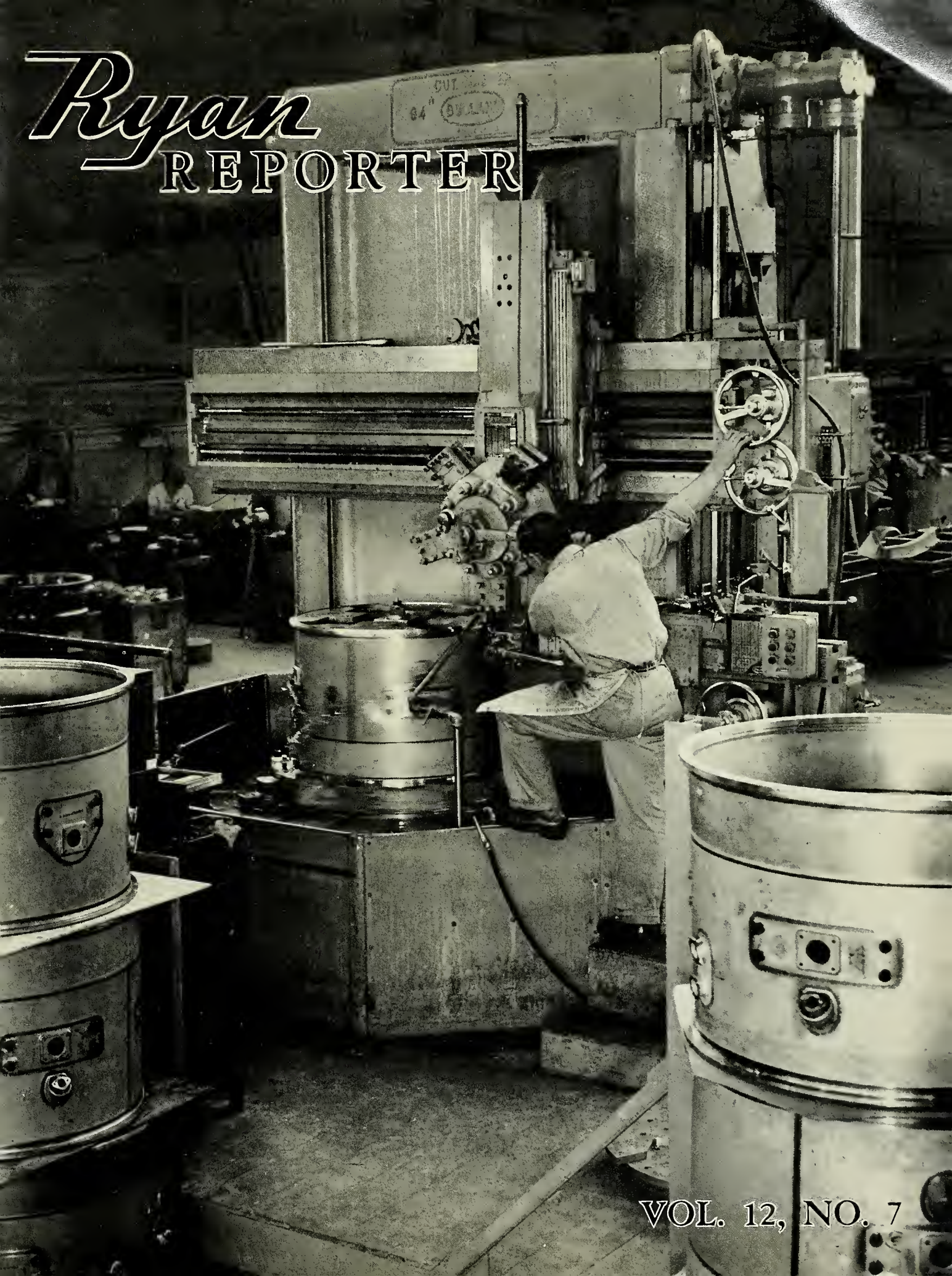
AIRCRAFT and AERONAUTICAL PRODUCTS

RYAN AERONAUTICAL COMPANY
LINDBERGH FIELD, SAN DIEGO, CALIFORNIA

Ryan REPORTER



VOL. 12, NO. 7

Air Force and Navy join commercial airlines in putting Douglas Liftmasters into air freight service

DOUGLAS Aircraft Company's new DC-6A Liftmaster is a slick cargo transport—and Slick Airways, Inc., largest scheduled domestic carrier of air-freight in the nation, is proving it!

Now in volume commercial and military production at Douglas' Santa Monica plant, the Liftmaster will soon be joining the airfreight fleet of American Airlines. The military services are also getting large numbers of Liftmasters, and for the Navy will bear the designation R6D-1; and for the Air Force, C-118.

The slickest trick yet performed with the Liftmaster—one which received national publicity—was the recent shipment of the heaviest single piece of machinery ever transported by a commercial airline.

When one of the four huge tie rods on a giant extrusion press at the Aluminum Company of America plant in Los Angeles failed, it was necessary to get a replacement in a hurry.

The substitute part, made at Philadelphia, weighed 20,000 pounds, was a 32½-foot long steel column, and when ready for shipment presented a problem in rapid transportation. The normal 12-day shipping schedule had to be stepped up or else production of aluminum extrusion parts for Southern California aircraft plants would be halted.

Slick Airways, serving 54 major cities throughout the country, came up with the answer.

At the Philadelphia airport a long-armed crane sleekly slid the steel cylinder, crated and cradled, through the huge main cargo door. A hundred feet of steel cable lashed it to the cargo rings in the floor.

Four hours later a big Douglas Liftmaster was in Kansas City, slurping gasoline. A routine crossing of the Rockies, and by daylight the DC-6A was slowly circling the Burbank airport waiting until it was light enough for television to record the historic shipment.

Getting Alcoa's vital shipment—one rod and four 900-pound collars—out of the Liftmaster wasn't as easy as getting it in, but Slick freight handlers, aided by Douglas engineers and cargo specialists, did the job.

To carry huge cargo loads at more than 315 m.p.h.—a Liftmaster has flown from San Francisco to Los Angeles in less than an hour—the DC-6A is powered by four Pratt & Whitney R-2800 engines rated at 2500 takeoff horsepower with alcohol-water injection and 1900 horsepower maximum continuous cruise power.

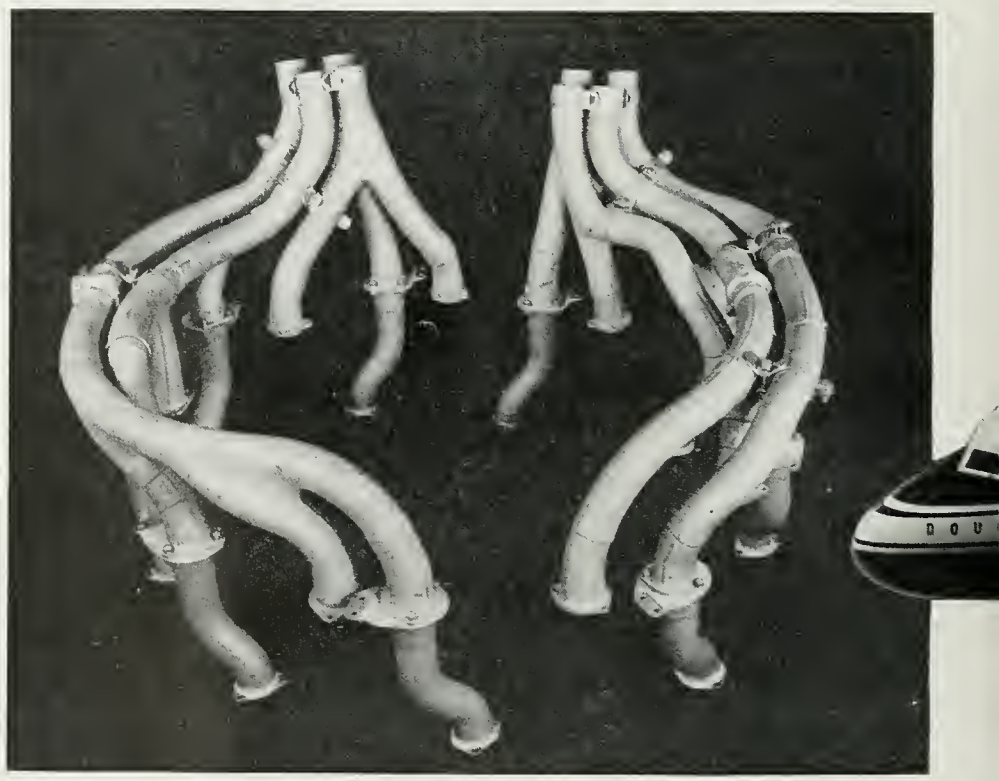
The Ryan exhaust systems which serve these engines are unique in that they are the first ejector-type used with commercial aircraft. By accelerating the velocity of the escaping exhaust gases, as they are discharged to the atmosphere, these "jet stacks" utilize their thrust to add an extra 15 to 20 miles per hour to the DC-6's performance.

Previously used on military aircraft only, ejector-type exhaust equipment was not employed for commercial planes because its high noise level and bright glare characteristics made it obectionable from a passenger comfort standpoint. Ryan engineers overcame these disadvantages by a design innovation which provides that the offending gases are discharged on the outboard side of the engine nacelles—thus using the nacelles as glare and sound shields.

To accomplish this, the installation was conceived in the form of a group of small diameter tubes, each of which connects with two (siamese) or three (triamese) cylinders. All of the tubes

(Continued on page 19)

SLICK



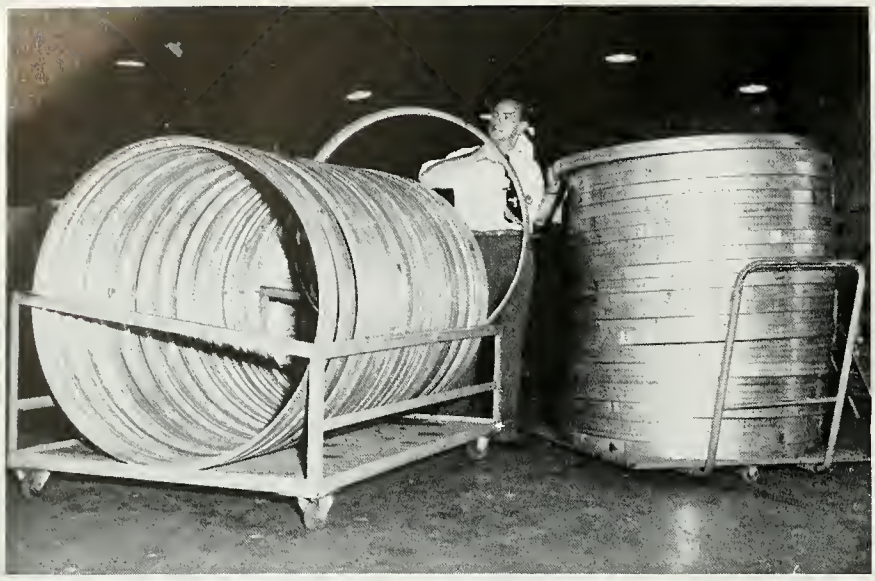
Ryan exhaust system for Douglas DC-6 engines is first commercial installation which augments plane speed by harnessing jet thrust from escaping exhaust gas.

ng-life Ryan exhaust manifolds are installed on a Slick DC-6A hich is first transport designed for commercial cargo service.

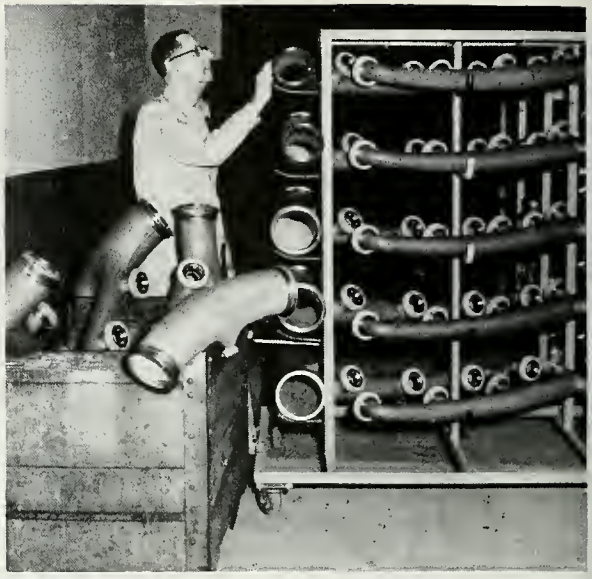
Heaviest single item ever air lifted by commercial means is this 20,000 lb. steel column being loaded into Slick's DC-6A.

LIFTMASTER

Patterned after the famed Douglas DC-6, the Liftmaster is designed to set new low freight rates for transcontinental runs. With a 315 miles-per-hour cruising speed and 30,000 pound payload, it fits nicely into Slick Airway's New York-Los Angeles cargo service.



Edges af rings for warld's largest external fuel tanks don't rub against each ather in new style rack, left, which separates them. Old methad shawn right.



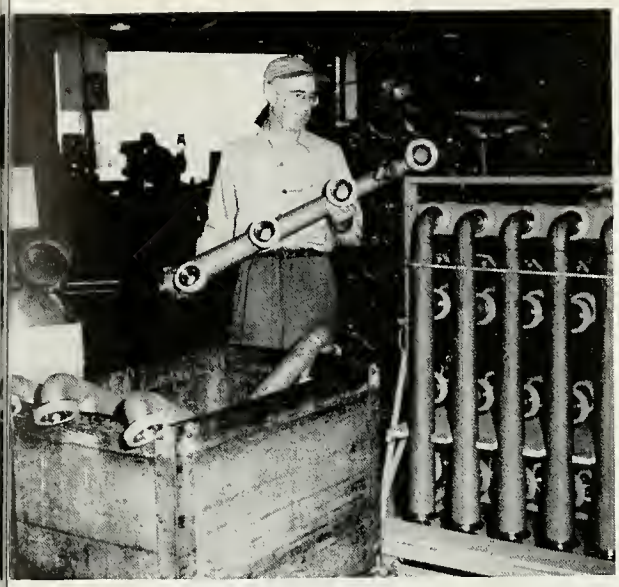
Neat starage af Pratt & Whitney callectar rings and headers, right, cantrasts with cart handling.

Custom-Tailored Racks

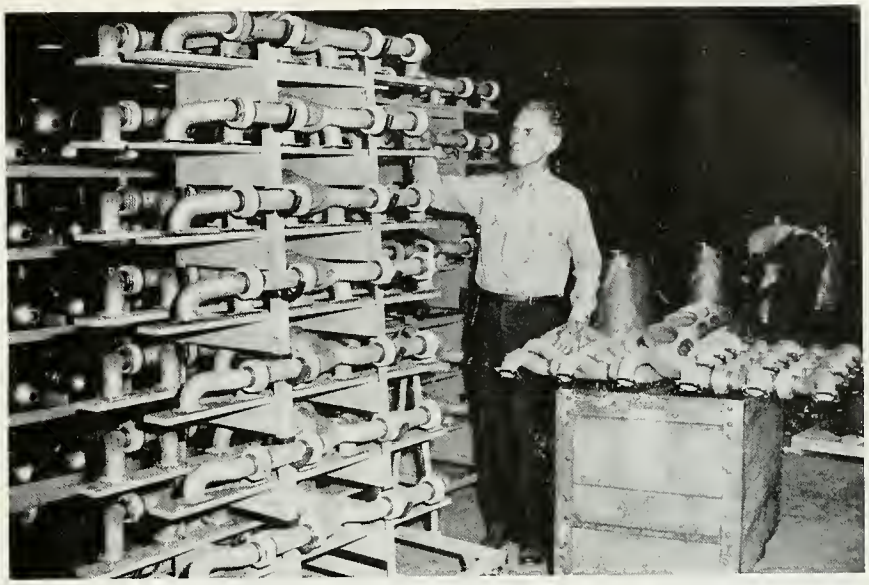
Modern design solves problems of handling bulky, odd-shaped parts

G.E. J-47 jet engine cawls, ance piled atap each ather, lawer right, naw have separate campartments in new rack.

Inner combustian chambers of jet engines, ance handled in ardinary carts, right, naw have special canveyance.



Header sections of Pratt & Whitney engines, no longer dumped in carts, left, don't jostle in rack, right.



Continental engine collector rings for Army tanks can be carried in large quantities in new rack without overhanging as they do in old-style cart.

MODERN design applies to materials handling, as significantly as it does to the streamlining of an airplane.

As the production of metal products at Ryan mounts, the efficient movement and storage of parts as they reach the advanced finished stage become increasingly important.

Three major factors must be taken into consideration—the protection of parts from damage or marring, the conservation of factory space and the ease of handling.

The most obvious means of transport for comparatively small parts is the "tote" cart, rectangular or square open-topped "box on wheels." The same cart which might be used for collecting scrap, has, in the past, been employed for moving valuable finished parts to the shipping department. As the carts were pushed by workers, there was ever-present danger that in jostling against each other, the odd-shaped pieces would suffer damage.

The method of loading was strictly up to the ingenuity of the individual. Since the carts were not made to fit the parts, the parts had to be dovetailed as well as possible to fit the carts. And in such cases as the exhaust system parts for the Continental tank engines, bulky section had to be placed on the top of the carts, overhanging on both sides.

Modern design, as applied by the mechanical design group of Ryan's plant engineering department, has come to the rescue. "Custom-tailored" racks, in various shapes, but all so compactly arranged that a minimum of space is needed to accommodate a maximum of parts, have been produced by the mechanical maintenance department to specifications of plant engineering. Some, such as those for the General Electric J-47 engine struts, have a "bird-cage" appearance. On others are rubber-encased supporting hooks that give them a similarity to clothes-trees.

The general principle is that each piece has its own allotted compartment to prevent surfaces from rubbing against each other. But the separation is performed with amazing space economy. Thus, one of the "bird cages" can hold 204 J-47 struts, several times more than a "tote" cart which occupies almost as much actual floor space.

And as for ease of handling, "tote" carts are "man-handled," while the newly designed racks can be pulled, several at a time, by a small conveying truck to inspection, shipping and final packing.

Modern design, as exemplified by bright, orange-colored racks neatly loaded with metal products, is helping speed output through more efficient materials handling at Ryan Aeronautical Company.

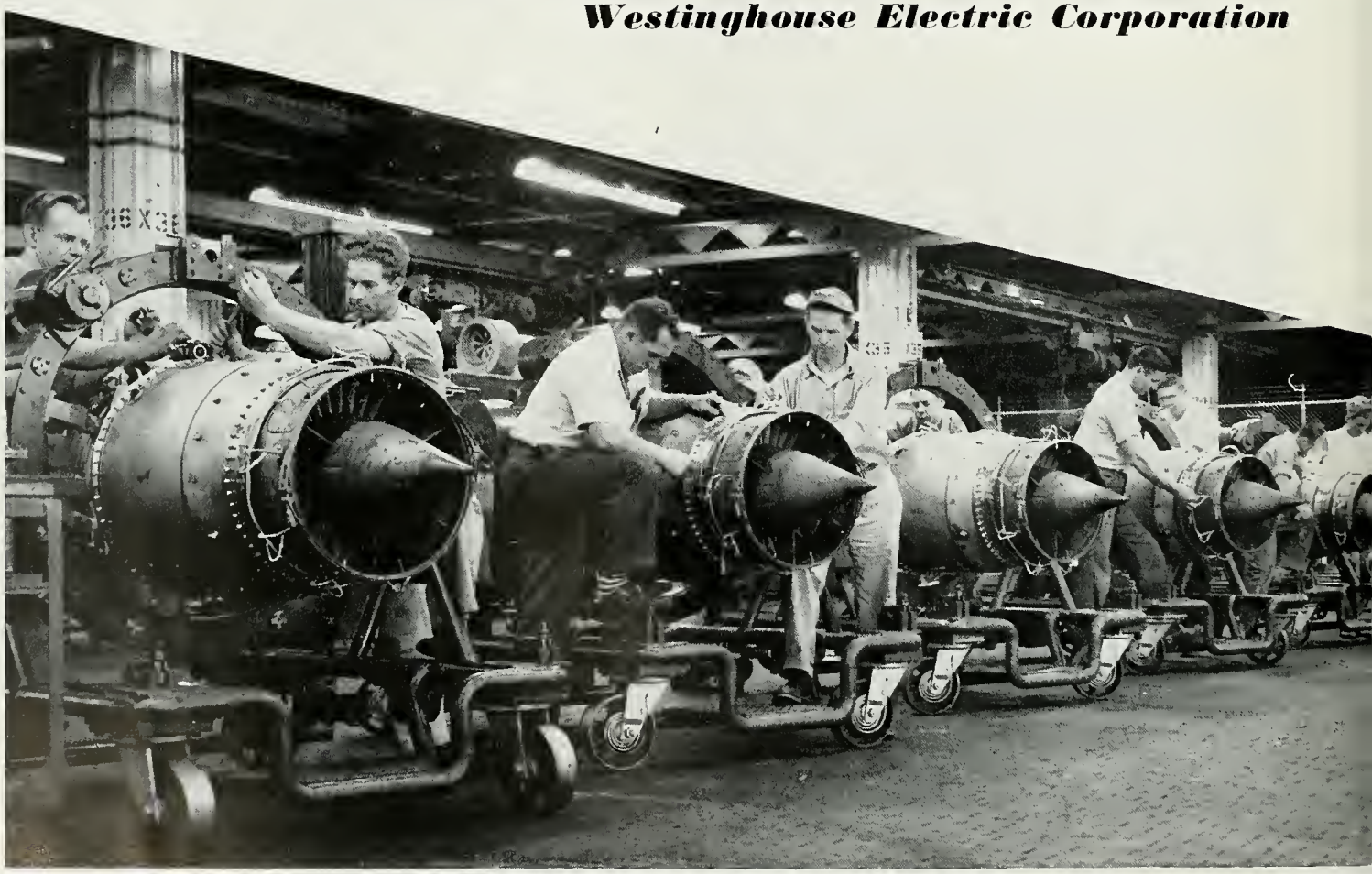
Newly designed rack can hold 204 G.E. J-47 jet engine struts, several times more than capacity of "tote cart," which occupies almost as much floor space.

THE JET ENGINE ARRIVES

by R. J. Kroon, Engineering Manager

Aviation Gas Turbine Division

Westinghouse Electric Corporation



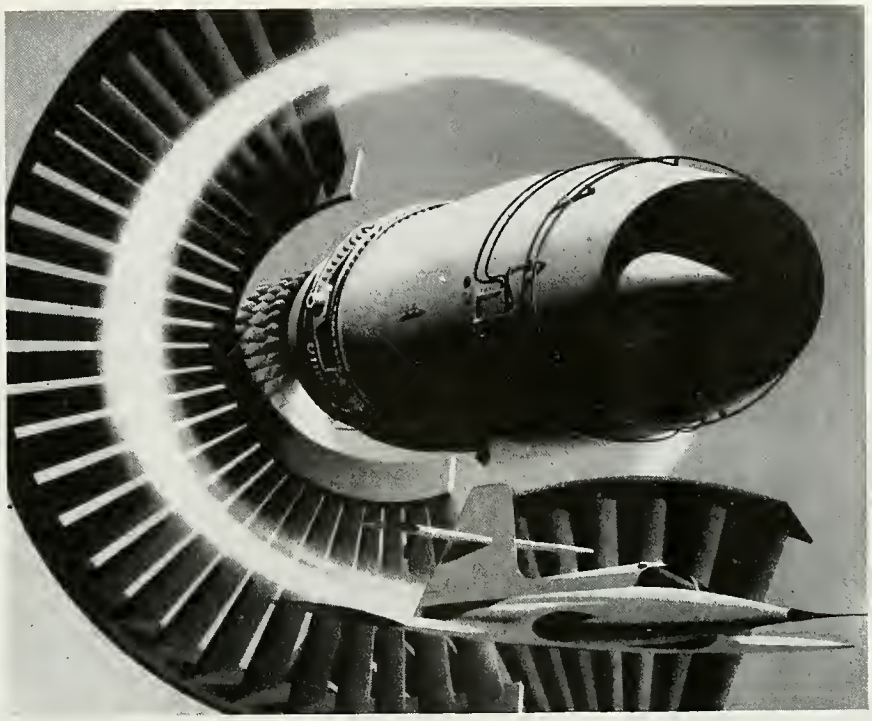
FROM the Wright Brothers' first flight in 1903 until 1945, the power plant has limited aircraft performance. The bulk and limited maximum power of the piston engine had blocked hopes of attaining the truly high flight speeds that aerodynamics would permit. But, in less than a decade, the turbojet engine has broken through these limitations and made possible great advances in aircraft performance.

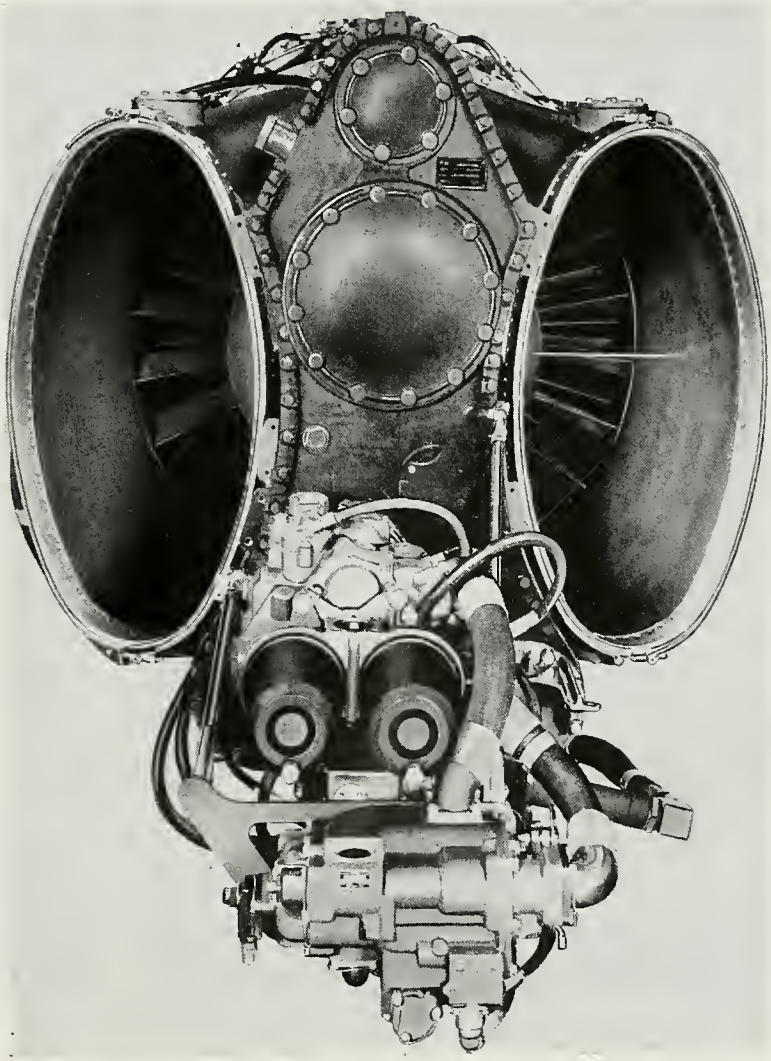
Early evaluation of the turbojet aviation gas turbine showed that it would be a light-weight power plant particularly adapted for operation at high speeds and altitudes. With jet propelled aircraft now flying at supersonic speeds and above 50,000 feet in routine flights, the turbojet is fulfilling the early promises made for it. At these high speeds, the power of the larger jet engines is already more than five times that of the largest piston engine-propeller drives and the installed weight of the jet engine is less than one quarter that of a piston engine of comparable power at high speed.

In evaluating present jet engine performance, it is interesting to note what is happening to the most important engine characteristics—efficiency, weight and thrust per unit frontal area. In 500 hours of operation a jet engine consumes an amount of gasoline that costs half as much as the engine itself. Fuel economy, therefore, is an important economic factor, independent of the longer range or higher payload it makes possible.

High fuel consumption appeared to be one of the weakest traits of the turbojet engine but continuing progress is achieving better fuel economy. In 1944, specific fuel consumption for a typical engine was around 1.25 lb. fuel per

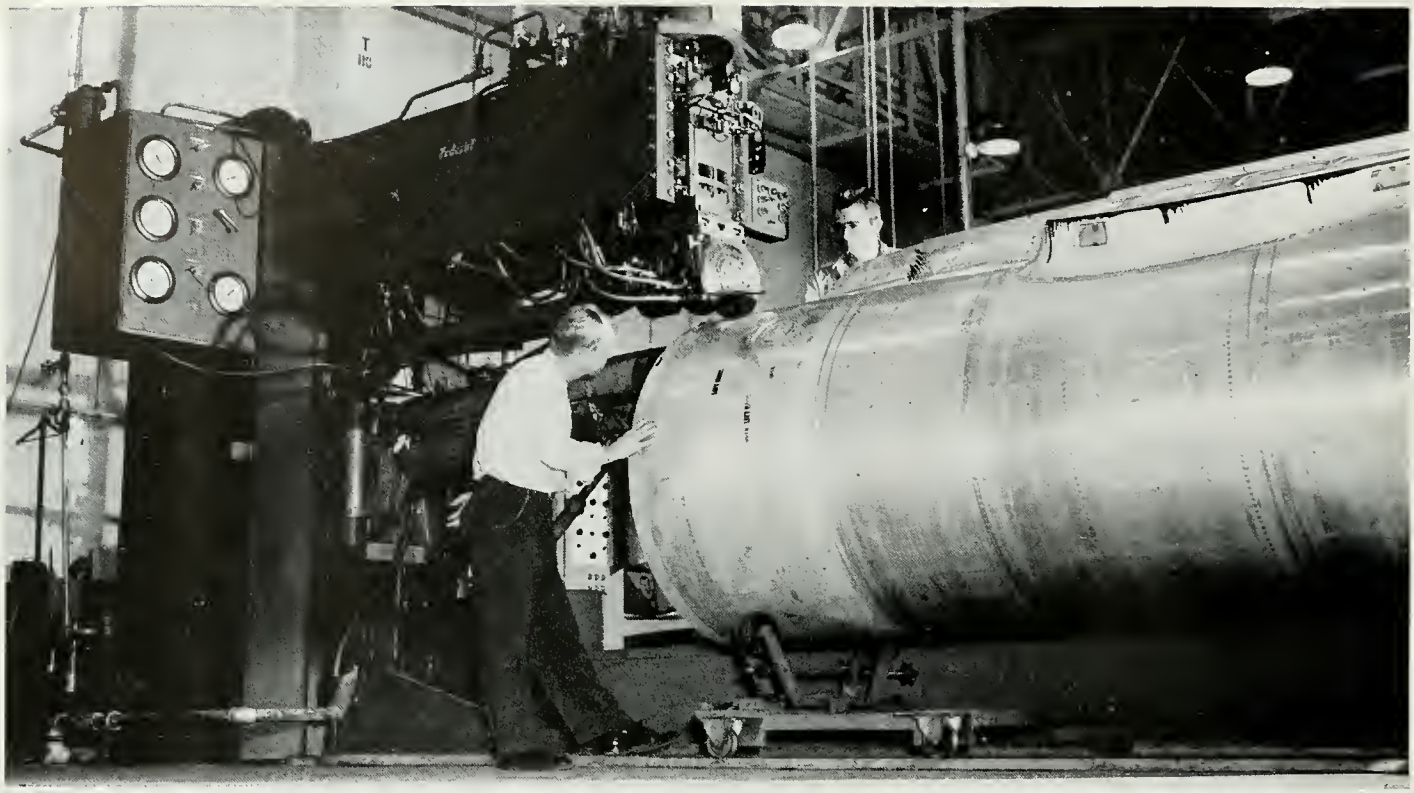
(Continued on page 16)





Needle-tailed jet engines get last minute touches at the huge Westinghouse turbojet plant at Kansas City, Mo. Destined for installation in the McDonnell "Banshee" and Douglas F3D night fighter, these power plants are axial flow in compressor design.

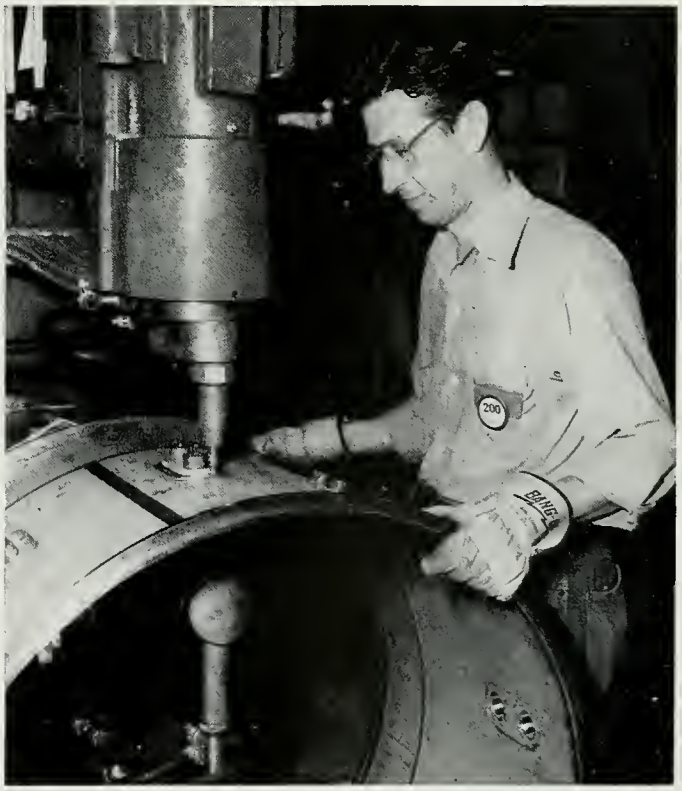
Looking head-on into the split Y-shaped air intake of the new Westinghouse J40-WE-6 turbojet, one of the most powerful jets in the world. Developing thrust equivalent to 14,000 h.p., it will have power doubled by the addition of afterburning unit.



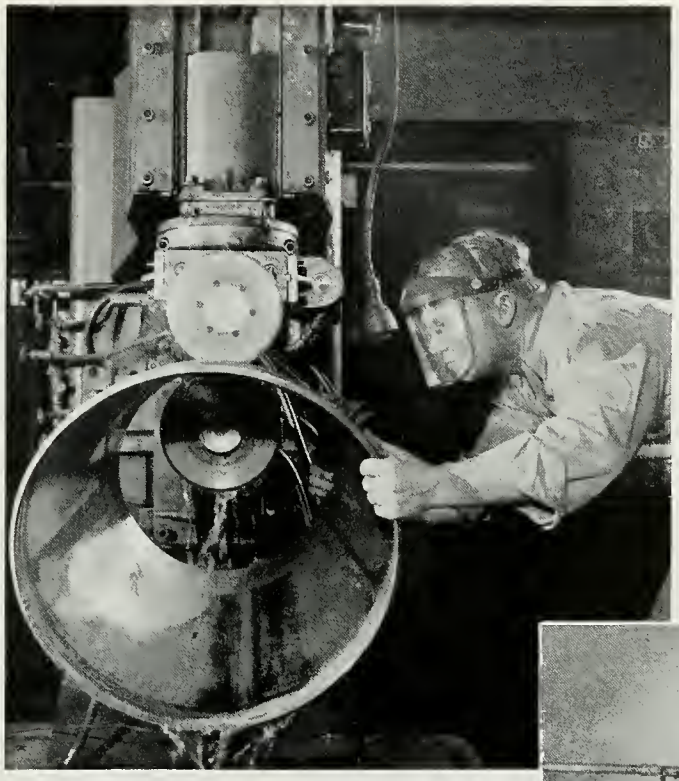
Towering over its operators, this mammoth Federal seam welding machine is one of eight used at Ryan to join sections of the largest external fuel tank ever designed for aircraft. Welders have 60-inch "throat" and handle work 60 inches from floor.

KILOWATTS DON'T WEIGH

Stainless steel sheets are "stitched" together in fast tempo by spot-tacking procedure prior to seam welding.



G-E jet engine cones, of vital function, are spot and seam welded with excellent high temperature endurance.

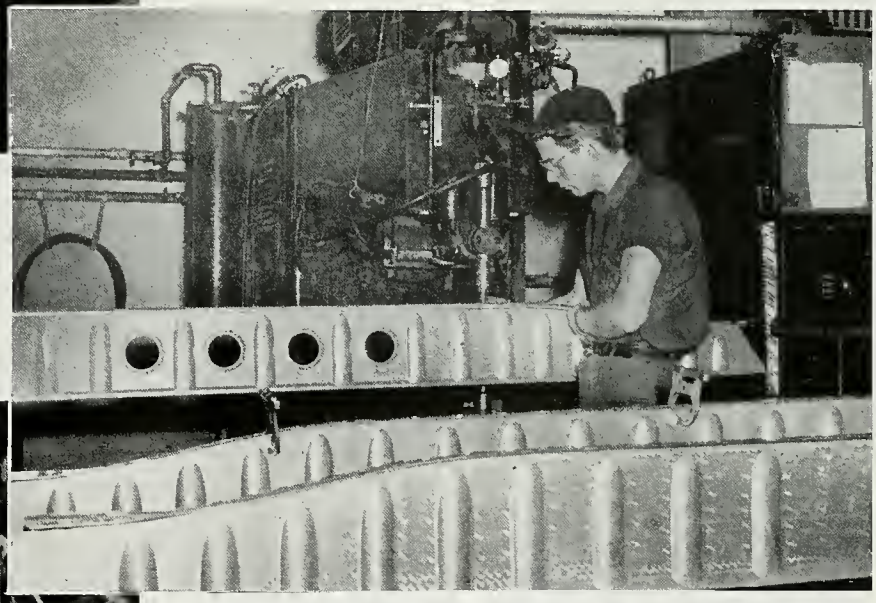


Rotating wheel-type electrodes form a gas-tight continuous seam of overlapping spots.

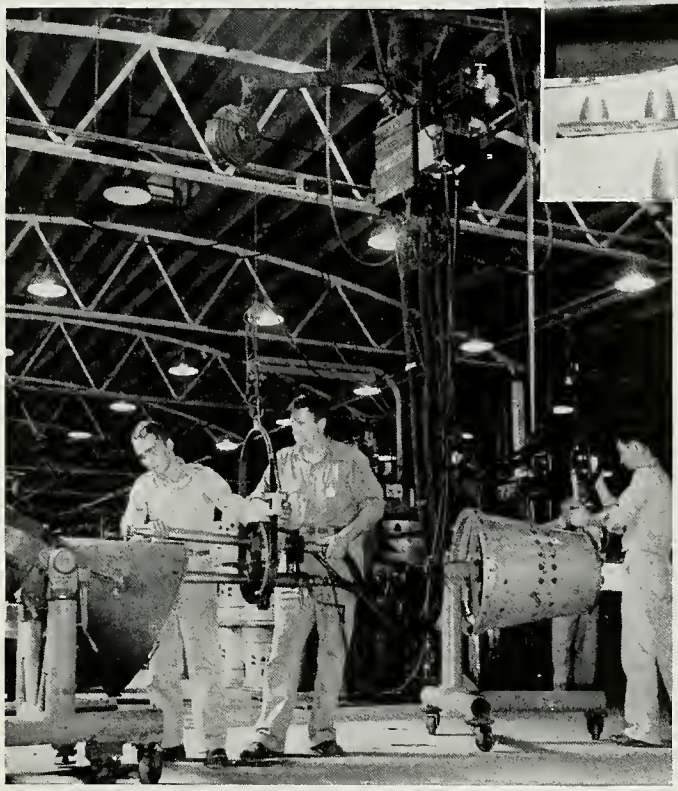
ANYTHING

In the weight-conscious aircraft industry, spot welding does a fast, clean job of weightless fusing

SPOT welding is the star performer in joining metals at Ryan. With years of "know-how," Ryan is using the most modern facilities to "stitch" together exceptionally large structures and heavy-gauge metals. These new machines, largest of their type in the country, have been designed to Ryan specifications for accomplishing new techniques.



1,000 invisible, weight-less spot welds are used to make the strong, light floor beams for Boeing C-97 Stratofreighters.



Twin "gun," suspended from spring-looded reels, gives Ryan jet production area a mobile, flexible spot welding tool.

Only recently has spot welding attained top billing in the aircraft industry. Although long regarded as a promising performer, it suffered from a "prima donna" complex which handicapped its extended use. Inaccurate timing spoiled its execution. Insufficient current capacities and pressures limited its application to small, secondary components and thin-gauge materials.

Working in close liaison with production companies, such as Ryan, the welding machine manufacturers have overcome these former frailties. Modern equipment is now engineered to fabricate primary, load-carrying aircraft structures and heavy-gauge metals of practically every kind. Ryan is securing spot welded joints in stainless steels that are 100 percent efficient compared with an average of 60 percent efficiency for riveted joints.

(Continued on page 14)

Seven of the ten Navions which flew in to the Municipal Airport at Clementon, N. J., for a Ryan-sponsored service clinic and check-up.

NAVION CUSTOMER CHECK-UP

by William P. "Doc" Sloan

"THE sale of an airplane only *begins* when the purchase order is signed on the dotted line!" These words of Earl D. Prudden, Ryan vice president in charge of the Navion program, typify the attitude of the nationwide organizations which specialize in the sales and servicing of Navions. And with the increased tempo of military preparation throughout the nation and its resultant curtailment of business plane production, the post-sale care of Navions has become increasingly important.

Following through on this theme, Ryan initiated its first Field Service Clinic program in April last year. The original clinic team consisted of Jack Lucast and the writer, who joined the Navion program after World War II service when Ryan purchased it from North American in 1947.

A 13-year veteran Ryan flyer, Doc Sloan is well-known to owners of Navions all over the nation as a result of service clinic program.

Lucast, now field representative for the Metal Products Division of Ryan, had recently returned from Europe, in the spring of 1950, where he assisted the Field Forces in the assembly of Ryan Navion L-17s shipped to Germany for liaison duty. The success of that service clinic stimulated our interest in doing the same type of job for owners of commercially operated Navions in this country.

During the period from April to September last year, the team covered 30 of the 48 states and checked more than five hundred Navions. Response from own-

ers and Navion representatives was so overwhelming that Ryan decided to continue the program through 1951 despite the curtailment of Navion production. Results of the two years' clinics have proven to be one of the best investments in owner good-will ever undertaken by an aircraft factory.

Just what is this "clinic" business, and why has it been such a good thing for Ryan and the industry? Having traveled more than ,seventy thousand miles and checked more than eleven hundred Navions, we think we have the answer: The entire program has been a mutually beneficial undertaking to the owners, dealers, distributors and the factory.

To give you an idea of how it works, let's take a typical Navion owner. His plane has flown in the neighborhood of four or five hundred hours and is as much a part of his business as the fleet of trucks and automobiles which his firm employs. Although well past 40, he is flying his own airplane, and uses it several times a week to cover his territory, or to make a quick country-wide tour to better his business.

Three weeks before the clinic team is due to arrive in his area, he receives a letter from Ryan advising him of the dates, and a few days before the team arrives, a letter from the dealer or distributor in the area confirms his appointment at the nearest Navion service shop. Despite the fact that his business address is more than a hundred miles from the dealers (owners have been known to fly more than six hundred miles to meet the clinic after being unable to keep an original appointment) he arranges his day to arrive on schedule for the inspection.

His prop has barely stopped turning before he is greeted by Walt Balch, Ryan's veteran service manager, who has flown in the day before with us in the company's Super 260. Equipped only with a flashlight each, a mechanic's creeper, and an inspection form, we swarm over the ship for the next forty minutes, muttering monosyllables and conversing in a cryptic sign language generally reserved for hopeless cases.

But at the end of that forty minutes, we're able to render a written report to the owner covering the life history of the plane from the day it rolled off the factory assembly line down to the last time a careless hangar boy dented the underside (inboard) of the left elevator skin. Every discrepancy discovered is gone over in layman's language with the owner.

By the time the ground inspection is completed, Mr. Navion Owner knows exactly what condition his airplane is in, which bulletins, if any, need accomplishing, which items need attention immedi-

(Continued on page 20)

"Doc" Sloan, center, goes over an inspection form with a few of those attending service clinic at Buffalo. L. to R.: Walt Balch, Ryan service manager; Navion owner G. H. Godsall of Ottawa; Sloan; Navion owner Ernie Taylor of Ottawa and Jack Gibson, Maintenance Supervisor for Anderson Aircraft at Toronto, Canada.

STATISTICS

Approximate mileage flown	40,000
Airplanes checked	621
Clinics held	41
Hours flown (including checks)	610
Time "on the road"	18 weeks
Time loss because of weather	1½ days
Appointments missed	None
Average weekly flying time	35 hours
Items per ship checked	110
Cost to Ryan per Navion checked	$20.00

Navions on ramp at Southern Ohio Aviation at Dayton, Ohio, waiting their turn for a complete inspection. Twenty-eight ships checked during three-day period.

Fast rescues at sea will be primary Navy use of Piasecki HUP-1. With hydraulic hoist and big internal rescue hatch, one man can fly and pick-up at same time.

IT'S easy to spot a Piasecki. With a sleek airplane-like fuselage and overlapping twin-tandem rotors, this versatile helicopter incorporates the benefits of both fixed and rotary wing aircraft in an eye-catching design. Latest exponent of this efficient configuration is the HUP-1 which is joining the fleet in sizable numbers to operate from carriers, battleships and cruisers.

Piasecki pioneered the twin-tandem idea, uncovering the world's first successful model in response to the U. S. Navy's search for a stable rescue vehicle which could hoist men from a life raft or jungle refuge. This innovation permits high overloads and the shifting of passengers in flight without disturbing balance requirements. Also, the counter-rotating rotors counteract torque without the expenditure of extra power. In swift stride, Piasecki has adapted their design to huge troop and cargo carrying helicopters and is currently building the XH-16—world's largest and longest ranging rotary wing aircraft.

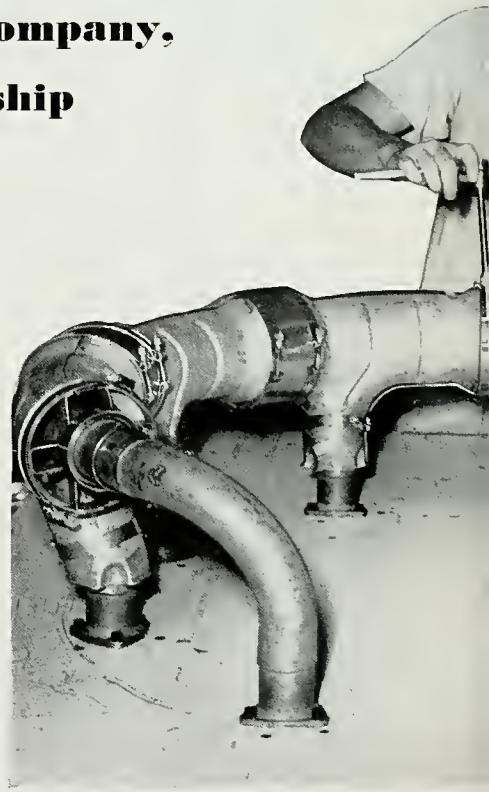
From inception, Piasecki selected Ryan

(Continued on page 14)

TANDEM WINDMILLS

Starting from scratch as a post-war company, Piasecki has spiralled to leadership on twin rotors

Piasecki engineers discuss fine points of Ryan shrouded exhaust manifold with C. L. Foushee, Ryan service manager. Continental R-975 engine and Ryan exhaust system form power package for Piasecki's HUP-1—Navy ship-boord helicopter.



Assembling a complete, shrouded exhaust Ryan, carefully checks dimensions of new exhaust system is shrouded to insulate heli

TITANIUM DEBUT

Captured only recently, shrewish titanium is being tamed to fit industry's needs

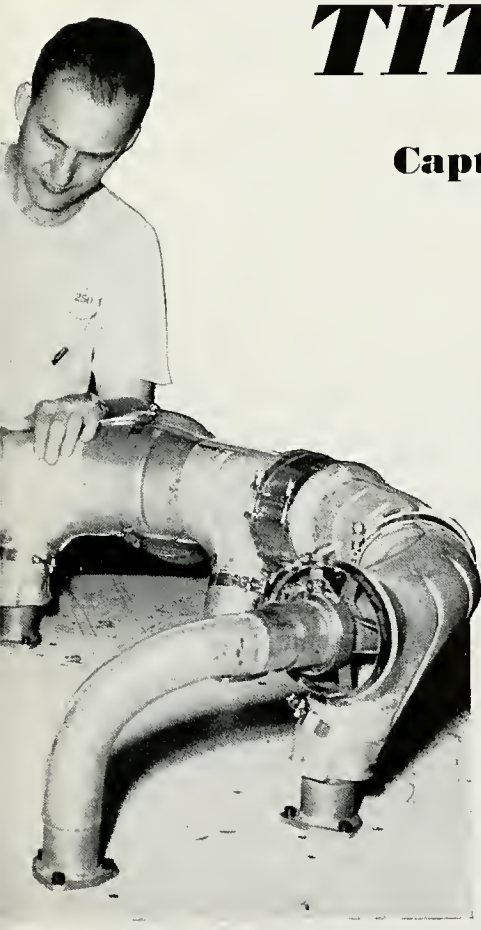
TITANIUM — most modern metal of industry — is nature's paradox. More than any other element, this metal seems to exhibit exasperatingly contradictory behavior. Neither new nor rare, it costs the fabulous price of $15.00 per pound. With an extremely high melting point for its weight — higher than steel — it still will not withstand continued use at high temperatures. So "affectionate" for other elements that it is never found free, and instantly combines with other substances when molten, it will not weld with any other metals by known processes.

In spite of this "Dr. Jekyll and Mr. Hyde" complex, titanium is endowed with some of nature's choice characteristics which seem to be especially planned for aircraft applications. For this reason, the Ryan Development Laboratories have recently completed studies of the bright newcomer, which involve the forming of intricate structures, by established procedures developed for stainless steel.

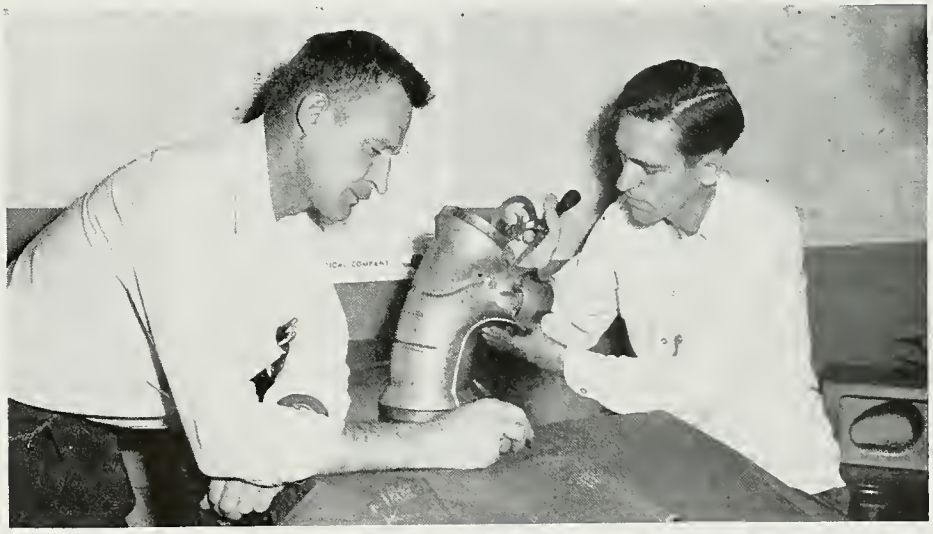
Because titanium falls between the aluminum and steel alloys in both strength and resistance to temperature, it

(Continued on page 21)

Titanium production is still meager. Expensive and eagerly sought sheets are rolled on light equipment of Allegheny Ludlum Steel at Watervliet, N. Y. plant.



n for Piasecki HUP-1, Clarence Benbow of d sections fabricated from titanium. This r from heat produced by "buried" engine.



Ideal application for titanium is this Ryan shroud section which operates at temperatures above aluminum limits. Fred Dever, spot weld engineer (left) and Dave Adams, metallurgist, check tolerances of this experimentally formed part.

CHIMNEYS FOR JET ENGINES

B-36 ↑

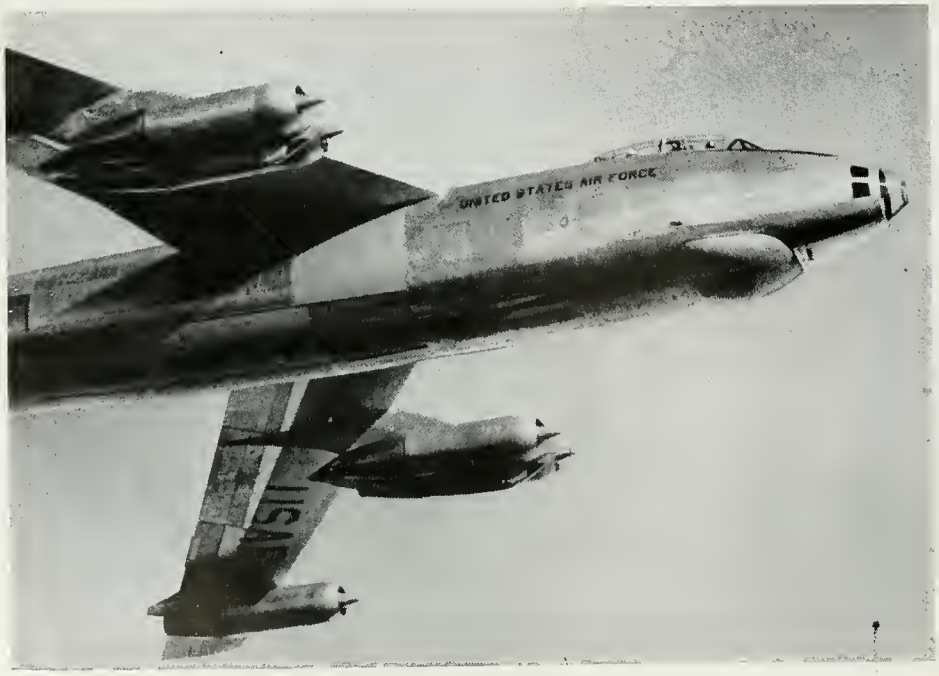
Convair B-36, battleship of the air, has increased performance to more than 435 m.p.h. at 45,000 feet with G-E turbojets in pod.

←XC-123

Bell-built pods with Ryan tail pipes are fitted to versatile Chase transport adding jet power to make it tri-purpose pack plane.

B-47 ↓

Boeing B-47, first sonic-speed bomber, uses knife-thin wings and pod-type power packages to attain projectile - like sprints.



OBSERVERS at the airport stared after the big silver transport which was zooming skyward. With a roaring swoosh, the sleek Chase XC-123A had left the runway after an unbelievably short roll of about 600 feet—far shorter than that used by most jet fighters.

Into the air on its maiden flight, the experimental jet transport hung up two "firsts" for American aviation. First all-jet cargo plane flown in the U. S., and first plane in the world to fly with jet power, piston power and without power (as a glider), the Chase flight also marked a manufacturing milestone. It became the third important aircraft to fly with jet "pods" built by Bell Aircraft Corp. and incorporating Ryan jet engine tail pipes.

A pair of the compact twin power packages, the same as used on the Boeing B-47 Stratojet, were fitted to the slender underwing of the Chase transport to give it such remarkable performance. These are the same potent pods which have helped boost the Convair B-36 bombers, as well as the B-47, into world leadership. Enclosing two General Electric J-47 jet engines, for which Ryan builds major components, and fitted with Ryan tail-pipes, each pod is capable of generating in excess of 10,000 pounds thrust.

Labeled "tail-pipes" through common usage, the Ryan exhaust sections are more accurately described as "nozzle assemblies." Similar to the exhaust sys-

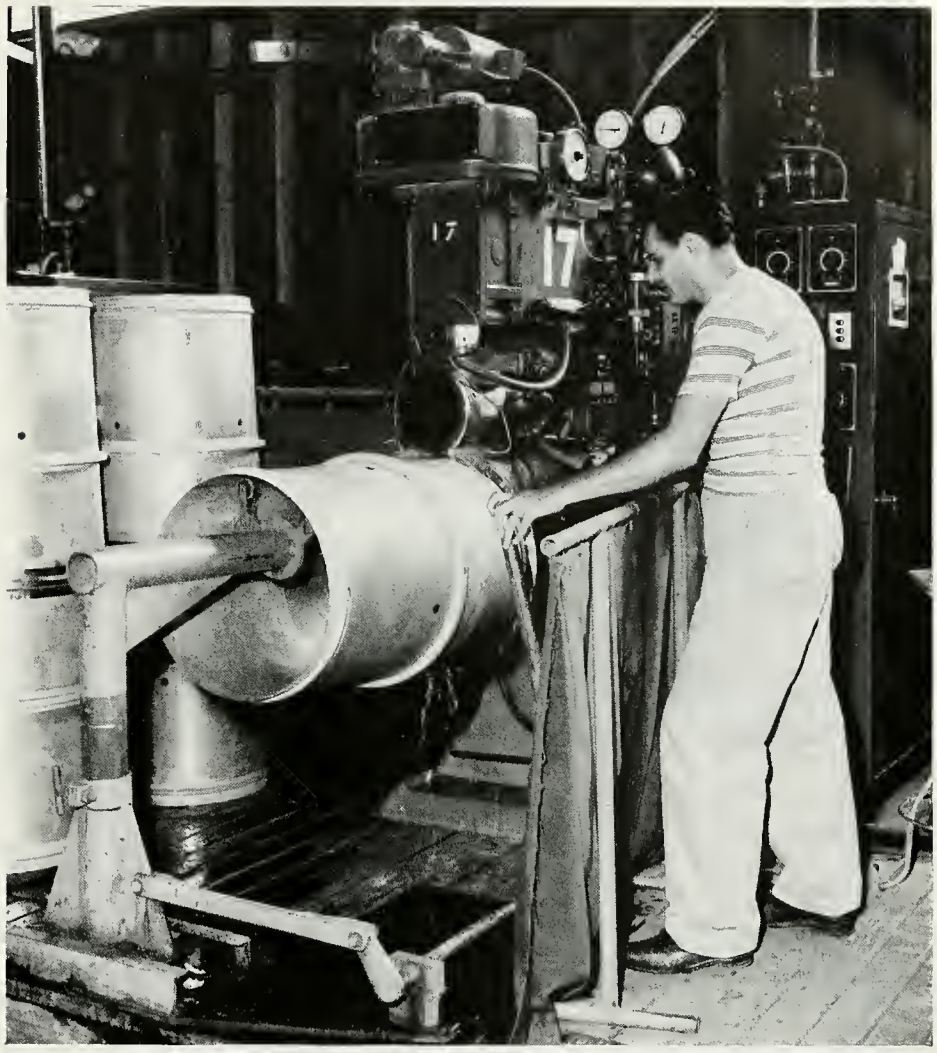
tem on a piston engine they eject volcanic gases to the atmosphere. But, they have another more important function. Their design influences engine performance.

Like stratospheric cannon, these flamethrowers discharge a searing blast of exhaust at 1200 miles per hour. Three tons of hot gas charge through their 19-inch openings per minute. Even slight variations in the diameter of these tubes immediately affect exhaust temperature and velocity, to produce surges in thrust. They must be carefully designed to generate maximum thrust within temperature limitations.

Impressive quantities of Ryan nozzle assemblies have been shipped to the Bell and Boeing Aircraft companies for installation in the Bell pods which are harnessed to B-47 and B-36 wings. Ryan builds them from type 321 stainless steel of .035″ gauge.

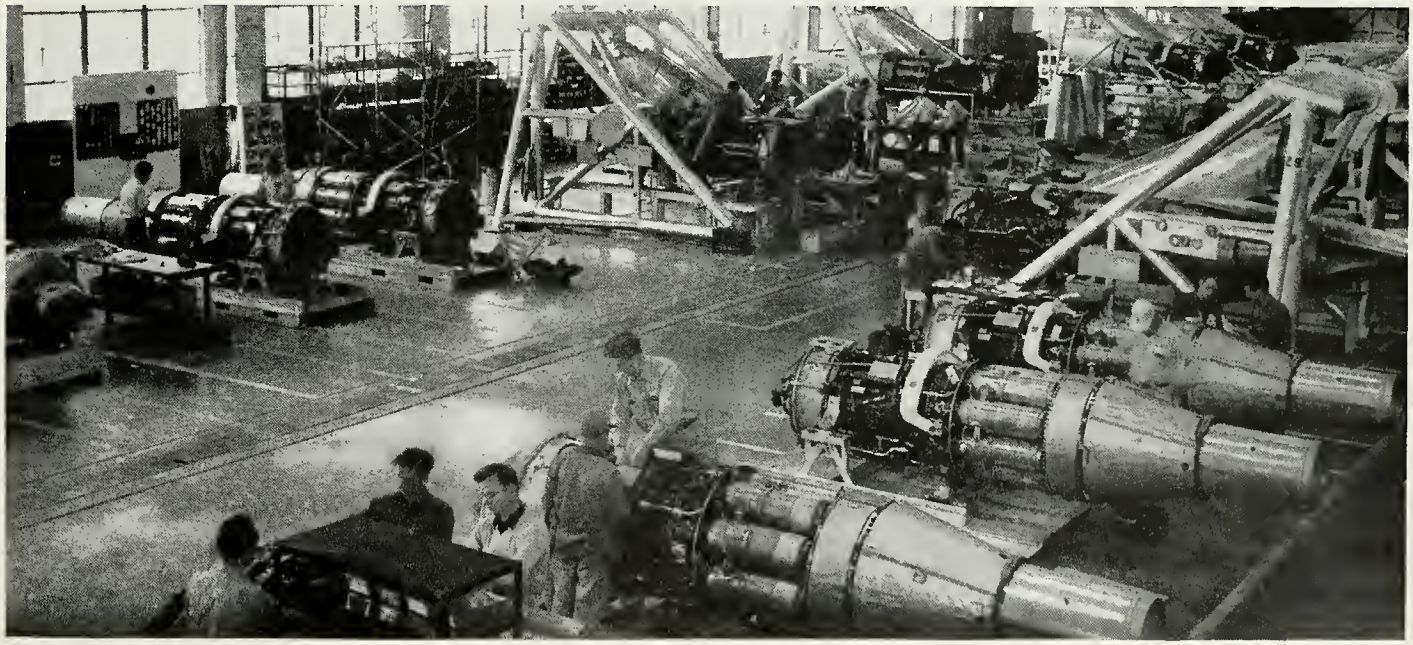
The gleaming sheets are rolled into cylindrical form, with slight taper, and precisely cut for Heliarc butt welding of the longitudinal seam. Machined flanges

(Continued on page 18)



Ryan seam welds flanges on tail pipes at forward end where clamps attach them to G-E jet engines. These gas barrels go into B-47, B-36 and XC-123A pod units.

(Foreground) Ryan tail pipes are mated with G-E turbojets. (Background) Bell production line for B-47 twin-pod assemblies.



600-Ton Press Arrives at Ryan

The heaviest piece of equipment ever installed in the Ryan plant arrived recently on two railroad flat cars and will be used to speed production of jet engine parts. The 223,000-pound mechanical press has a 600-ton pressing capacity and is able to form, shape and cut in triple-purpose operations. So heavy is the press that eight steel pilings must be driven 65 feet deep for its foundation.

TANDEM WINDMILLS

(Continued from page 10)

to develop the high temperature exhaust equipment for its product. The relationship has proved so satisfactory that Piasecki states, "We have found that Ryan gives such excellent service and maintains such efficient engineering liaison between our plants that we have concentrated all of our exhaust systems with Ryan for all past and present production helicopters."

In addition to the manifolds for the Continental R-975, 525 h.p. engines used in the HUP-1, Ryan is currently building stainless steel exhaust equipment to serve the Wright R-1820, 1425 h.p. power plants for Piasecki's YH-21A. These are radial, air-cooled engines which are buried in the central part of the aircraft close to the centers of gravity. To insulate the aircraft structure from the heat of the exhaust systems, Ryan also fabricates special light-weight shrouds of stainless steel which cloak the manifolds.

With the YH-21A, Piasecki has accomplished another "First" — first helicopter designed for Arctic rescue work. Ordered by the Air Force, this "omniphibious" model can operate from snow, ice, water, tundra, marsh and land by means of specially devised gear which combine wheels, floats and skis in one compact unit. Capable of transporting as many as 27 persons in emergency rescue work, the YH-21A can also serve as a troop transport on combat missions.

In winning the Air Force competition for the world's largest transport helicopter, Piasecki conceived the streamlined XH-16 which has a DC-4-sized fuselage and 85-foot diameter rotors. They didn't stop there. The big 'copter features a radical quickly-detachable capsule which doubles the payload and telescopes unloading time to an instant. With the size of a Greyhound bus, the cargo capsule hugs the underside of the fuselage in flight. At destination, it can be released and another pre-loaded unit picked up and whisked away.

In the HUP-1, Piasecki has achieved a long-sought objective in flight control. In cooperation with the Navy, a Sperry autopilot installation has successfully met all demands for automatic flight including "hands-off" hovering. This important attainment gives the helicopter night and "blind flying" utility which greatly expands its usefulness.

Piasecki has pyramided ingenuity and original thinking into an important industry. With its helicopters in service in the Air Force, Navy, Marine Corps and Coast Guard, it has pioneered the acceptance of large transport rotary wing aircraft. In the process of doubling its plant capacity, Piasecki is getting set to win more competitions.

KILOWATTS DON'T WEIGH ANYTHING

(Continued from page 7)

Spot welding progress at Ryan has been swift because its characteristics are tailored to aviation's needs. It is the fastest, cleanest method for joining metals and, what is extremely important, adds no weight to the design. A headless, invisible nugget of fused metal replaces the common rivet. It leaves aircraft surfaces smooth and clean with no protuberances to interfere with aerodynamic efficiency.

The new, big Federal and Thomson welders give Ryan engineers unmatched "fire-power" and precise "fire-control." Ten years ago standard spot welding equipment was capable of developing only 40,000 amperes on short circuit and exerting 1500 pounds pressure between the electrodes. Ryan's new tools squeeze sheets together with a force of 9100 pounds and can "fire" 120,000 amperes across a short circuit. This potent power can stitch together two sheets of quarter inch thick steel or two sheets of aluminum alloy 1/8" thick.

Most striking improvements in spot welding machines have come about in the electronic control, or "brain," which "tells" the machine what to do and when to do it. Spot welding is a sequence affair requiring the rapid application of exact amounts of pressure, heating and cooling. Secret of success of the work lies in the ability of the "brain" to control these extremely brief but powerful forces.

The control individually delineates the periods allowed for "squeeze," "weld," "forge" and "off" phenomena and cramps the whole cycle within a half-second of time, at the rate of 120 spot welds per minute. These controls "think" and act in terms of thousandths of a second (miliseconds.) They prove that the development of the electronic tube gave spot welding its present importance.

Ryan has pioneered in the use of spot welding techniques and today has the most modern and complete facilities devoted to electrical resistance welding in the aircraft industry. Ryan engineers have specified many of the new features, which are now offered in large welding equipment, as a result of the extensive amounts of welding of stainless steels and aluminum alloys which is accomplished in the San Diego plant.

A good example of the type of product which is now possible with present spot welding "know-how" is the huge external wing fuel tank which Ryan is building in quantity. Largest of their type ever produced, these torpedo-like containers depend upon spot welding for

their light-weight design and aerodynamic smoothness. They are fabricated with seam welded joints in which rotating electrodes produce a series of overlapping spot welds to form gas-tight seams without the need for sealing compounds. Not a single rivet head mars their sleek exterior.

Not long ago, spot welding would not have been considered for building such primary structures as floor beams for cargo aircraft. Today, Ryan is making complete sets of 49 floor beams for each big Boeing C-97 Stratofreighter — cargo carrier of the Air Force which can transport 68,000 pounds of freight. One thousand spot welds are placed in each "I"-beam assembly to form one of the lightest and strongest aircraft members.

IN the jet engine field, Ryan uses generous amounts of spot welding to form combustion chambers and transition liners of Inconel and cone and tail-pipe assemblies of stainless steel. The stainless steels and nickel base alloys are well fitted for spot weld design because their high electrical resistance makes short heating time possible. Operating at elevated temperatures, these jet components are vital parts whose failure could cause the loss of an engine and aircraft. Use of spot welding in these military applications is a high tribute to its modern acceptance.

Not content to merely use the new welding machines for standard spot welding practices, Ryan engineers are taking advantage of the equipment's unusual flexibility to obtain special spot welding effects. This work is opening new avenues of approach for designers by demonstrating the production benefits derived from the latest electronic controls. Among these special effects are:

Slope Control: In which the already brief period, during which the "fitting" of the welding current occurs, is further regulated so that the inrush of current is momentarily dammed and then allowed to build up in a crescendo. By this split-second restraint, added time is provided to permit the welding heat to be better absorbed by the metal surrounding the spot weld. This avoids the "splash," or explosion of hot metal from too sudden heating. With slope control, it is possible to place larger spot welds in smaller areas and to place them very close to outer edges — giving designers greater latitude.

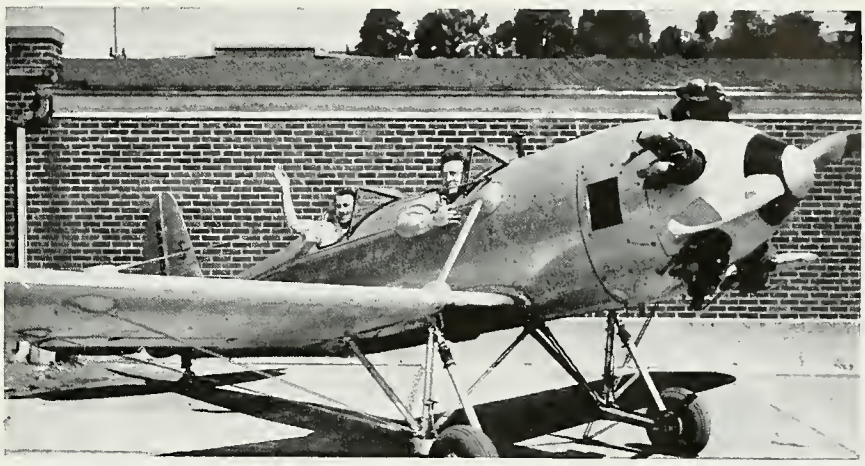
Tailing Heat Control: This refinement is a controlled diminution of current amplitude after welding to obtain a retarded cooling of the metal and prevent shrinkage cracks. Particularly valuable in the fabrication of aluminum alloys, which tend to cool quickly, this innovation allows the current to "die down" gradually in a few hundredths of a second.

Pre-Heating and Post-Heating Control: By arranging for a reduced heating current, immediately prior to welding current, it is feasible to preheat thick-gauge metals and allow the electrodes to seat better and also permit the spot welding of these heavy materials with lower currents. Post-heating technique is employed to ingeniously temper spot welds in heat-treatable steels without recourse to time-consuming furnace procedures. This precise control of the current after welding is designed to cause sudden cooling to "quench" the metal, and then a reduced heating is applied to "draw," or temper the spot welds and give them added strength.

Half-Cycle Firing: With the new electronic controls, Ryan engineers can harness fractional cycles from the three-phase, 60-cycle line current in the plant. By timing the firing of the welders to occur on half-cycles, extremely short heating currents can be planned. These fractional firings are useful for spot welding thin-gauge aluminum alloys which require high-current, short-time values.

Plus or Minus Cycle Firing: Ryan engineers have gleaned another advantage, which the new controls make possible, in this technique. By tapping the welding current wave on alternate plus or minus cycles, a unidirectional spot weld can be made which is uniformly off-center. In welding sheets of different thicknesses, this dislocation can be designed to occur so that the spot welds are cast deeper in the thicker sheet, to maintain uniformly strong adherence.

These are only a few of the new possibilities which can be realized when modern spot welding machines and experienced engineers work together to extend the usefulness of the process. Spot welding is on the march. If the recent years are a guide to the future, it will continue to take over more and more of the metal joining jobs which are being accomplished by other methods. After all, kilowatts are clean, quick and controllable and they just don't weigh anything.



RYAN PT-22 REPLACES AUTO

Although they live only eight miles from where they work, two Boeing Airplane Company employees recently found it more convenient to fly to their jobs than to drive.

James Patterson, left above, and Walter Woolcott, who reside in Renton, Washington, normally drive the eight miles to Boeing's main plant on the southern outskirts of Seattle.

But while attending special training classes on the opposite side of Boeing Field from this plant, they decided to take advantage of Patterson's war-surplus Ryan PT-22, because they could park it only a few steps from their classroom door. Getting there from Lake Air Park, on the east side of Lake Washington, each day was a matter of only 6½ minute's flight time.

Patterson and Woolcott have come out of the clouds, and they're using a car again. Their special training completed, they're back in the jig erection and maintenance department of the main plant. Although they could continue to make the trip by air, it would mean a long walk after parking the plane.

THE JET ENGINE ARRIVES

(Continued from page 5)

hour per lb. of thrust. Engines now in production average about 1.05 and further improvement is coming. Thermodynamic calculations show that, with reasonable component efficiencies, increasing the pressure ratio from 4 to 6 cuts down fuel consumption by about 4 percent. Increasing the pressure ratio to 15 saves another 12 percent of fuel, accomplished, of course, at additional cost and weight of compressor. We can expect to see engines with higher pressure ratios where fuel consumption is important — in long distance flying. Within the next decade, we may well see turbojet fuel consumption reduced to 0.7 lb. fuel per hour per lb. of thrust.

For a given aircraft, lighter engines permit longer range or higher payload. A typical weight for a 1944 engine was 0.55 lb. per lb. of thrust. Present production engines average nearer 0.40 lb. per lb. of thrust. Although many active developments favor weight reduction, there are several tendencies toward heavier engines.

A higher compression ratio, for better efficiency, requires more horsepower for the compressor, and hence more power from the turbine to drive the compressor. The additional power results in increased weight for both components.

The effect of higher flight speed also increases engine weight because the air is forced into the engine at higher density. This means increased horsepower in the compressor and the turbine and higher internal pressure in the engine. In elements where gas pressure governs the thickness of the structural elements, higher internal pressure means heavier walls.

Higher speeds also mean temperature of the incoming air is raised — often as much as several hundred degrees Fahrenheit. Because this temperature rise is multiplied in the engine, heavier materials may have to be substituted for light alloys that cannot withstand higher operating temperatures.

To develop better light-weight materials for these applications, specialists in the field like Ryan Aeronautical Company are conducting metallurgical investigations with ceramics and special high temperature alloys. The use of ceramic coatings on these alloys provides life-extending protection where oxidation and corrosion are major problems.

Operation at higher altitudes requires larger combustion chambers to maintain flame stability and combustion efficiency, which also increases weight. Increased requirements for auxiliary power from the engine, such as air conditioning apparatus, and the addition of larger engine accessories tend to increase a total engine weight. On early engines, accessories average 10 percent of the total but they have been as much as 30 percent.

A small frontal area for a given amount of thrust permits a smaller engine package with lower drag, ideal for nacelle and wing installations. With component improvements, which have brought about an increase in the amount of thrust obtainable from a given mass of air, and better external streamlining, the ratio of thrust to frontal area has been steadily increased.

For centrifugal engines, the thrust per unit frontal area has been increased from a representative 225 lb. per sq.

Pickling Baskets Made From Scrap

It's hard to find an idea that will save money, conserve critical materials and perform a better job —all at the same time. Yet that is exactly what the new Ryan pickling baskets have done since they were designed by the Plant Engineering Department.

By fabricating these baskets from stainless steel scrap which is produced in the punch-pressing of exhaust system flanges, Ryan has obtained a longer-life basket costing far less than those commercially available.

Required to take stainless steel jet engine parts and exhaust system components through some of the most corrosive solutions used in production processes, the pickling baskets were formerly made of wood. Douglas Fir 2″ x 12″ lumber, doweled together with wooden pegs, was used to fabricate the containers which are 62″ long, 27″ wide and 22½″ high. They had to be weighted with lead to cause them to submerge in the baths. Because the lead was readily attacked by the acids, it was necessary to enclose it in protective stainless steel coverings.

Wood was not satisfactory for these applications because it soon rotted away, leaving contamination in the tanks. When Ryan changed the pickling process to include a high temperature molten salt bath, wood was immediately ruled out because the heat of the bath would ignite the wooden baskets.

Looking for a suitable material which would stand up under the attack from molten salt and the hot and cold combinations of nitric, sulfuric and hydrofluoric acids, Ryan plant engineers Melville Payne and C. C. Hasty, Jr. eyed the scrap which was being produced at the punch presses. Here, exhaust port flanges are neatly punched out of strips of stainless steel that are 5/16″ thick —a 65-ton punch job. They designed a basket to be built from this scrap material and gave the plans to Elmer Russell, of Mechanical Maintenance, to execute.

The scrap was straightened, cut to length and arc-welded together for experimental baskets. From the first, these containers were eminently successful. With a service life of three months, compared to the ten-day existence of the old wooden baskets, they have saved substantial amounts of money. Because scrap stainless steel is used, a worth-while conservation of the supplies of this metal is also effected.

IN A FINE PICKLE—Pickling baskets made from stainless steel scrap are handled in overhead conveyor system through solution tanks by Ignacio C. Munoz.

Capable of carrying up to 1,000 pounds of parts, the Ryan baskets are designed with removable bottoms which can be released by simply turning dowels. Maximum drainage is obtained in their construction so that no salts or acids will be dragged out of the baths, and to prevent explosive splashes when water accumulations are immersed in molten salts.

By placing the baskets on mobile dollies, Ryan loads them with parts directly from the heat-treating furnaces. Then they are transported to the acid tanks and processed through pickling without another handling of the parts. This has stepped up production time and eliminated the labor involved in loading and unloading parts dollies.

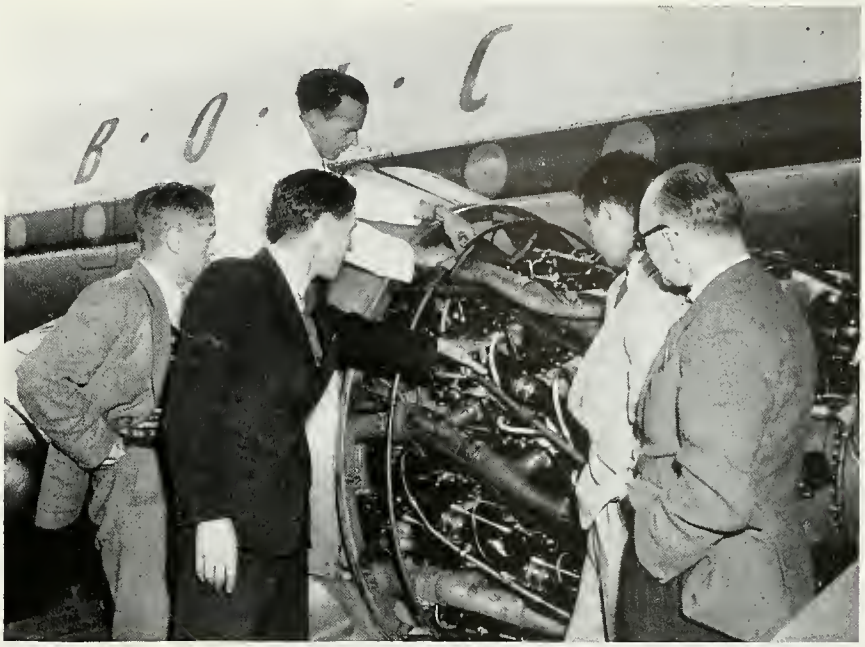
ft. in 1944 to a typical value of 400 lb. per sq. ft. in 1949. Axial flow units, which started off with considerable variation, have now passed a mark of 600 lb. per sq. ft.

SEVERAL means of thrust augmentation have appeared, all based on the basic jet propulsion law that engine thrust is the product of mass accelerated and velocity of exhaust. Hence, to increase thrust, either the mass or the jet velocity, or both, must be increased. Burning additional fuel in the tailpipe beyond the turbine—afterburning — increases the temperature and consequently the volume and velocity of exhaust gases. This can yield some 40 percent additional thrust at standstill and more than twice this amount at higher flight speeds.

While afterburning is expensive of fuel, it provides short bursts of terrific power and is particularly suitable for interceptor-type aircraft where flash performance is desired. Considerable investigation in this field has been done by Westinghouse and by other companies utilizing Westinghouse jet engines for their research. Typical was the development work done by Ryan Aeronautical Company under Navy Bureau of Aeronautics contract which resulted in the first publicly announced afterburner in this country.

One of the developments upon which the capabilities of the gas turbine depend is progress in high-temperature alloys. Pre-war materials have been gradually improved to meet the demands of high speed, precision-built jet engines. Reliance on creep-rupture and fatigue testing to evaluate materials for use at high temperatures has been customary practice. Now, for the kind of operation to which gas turbines are subjected, additional attention is being paid to the effect of "thermal shock," or rapid heating and cooling cycles, on the behavior of jet parts. Materials that are brittle under these severe conditions can easily crack in a relatively few hours.

Early experience with jet engines proved that at increasing altitudes, with reduced air density and lower ambient temperatures, efficient combustion becomes more and more difficult to sustain. Under such conditions the efficiency of the combustion chamber can deteriorate severely and the flame might even go out completely. Several early engines ran into such operational troubles below 30,000 feet. With continuing research and development it has been possible to increase considerably the altitudes at which performance of the combustion chamber deteriorates.



Checking Ryan exhaust system on a BOAC Stratocruiser at the London Airport, C. L. Foushee, Jr., (second from right), Ryan Service Representative, confers with BOAC technicians. L. to R.: C. T. Snell, Section Inspector; A. Stoner, Inspector; F. E. Hart, Base Foreman; and G. O. Briars, Senior Inspector.

Ryan Service Engineer Confers in England with BOAC

Life in England, where the average wage of an aircraft sheet metal worker is 46 cents an hour in a 44-hour all straight time week, is drab and grim.

This is the report brought back by C. L. "Frenchy" Foushee, Jr., Ryan service representative who spent two weeks in London, Bristol and Filton (a suburb of Bristol), conferring with British Overseas Airways Corp. officials on maintenance of Ryan exhaust systems in the airline's transatlantic Boeing Stratocruisers.

"The average wage of the British working man is 6 to 9 pounds a week, or $16.80 to $25.20 a week," Foushee said. "With the high prices of staple items, and staggering taxes, families really have to pinch pennies to make ends meet."

Aircraft production in England still consists of considerable handwork, which requires that sheet metal mechanics, for instance, must meet far more exacting standards than in this country, Foushee observed.

Although generally the quality of workmanship is good, such jobs as welding are not performed with the degree of excellence found in the United States, he said.

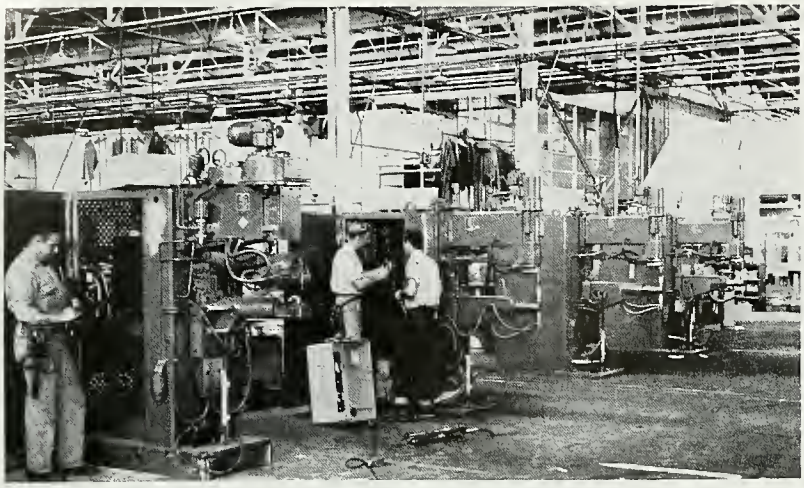
The production rate is slower than the U. S. industry's due to fewer machine tools, but in some categories, such as commercial jet transports (which are in actual use on some runs), England paces this country.

The Ryan exhaust systems have been performing extremely well under the strenuous conditions of overseas flight operations, Foushee learned. His visit provided the first on-the-spot advice and information on maintenance practices received by B.O.A.C. at its shops in Filton and its line station at the London airport.

FLAME stability generally improves as gas velocity through the burner is decreased. Larger combustion chambers improve combustion, but combustor performance at these altitudes must be bought with increased size and weight.

One of the drawbacks of early combustion chamber designs was their relatively short life, limited often to a few hours' operation. Careful attention to the structural requirements of combustion chambers has made possible a manifold increase in combustor life. One of the most successful means of improving the mechanical reliability of combustion chambers has been the provision of a blanket of relatively cool air over the combustion walls. Thus the metal remains at moderate temperatures despite the close proximity of flame temperatures of some 3700° F. Several combustors in production-type engines have operated through periods of 600 hours and were still fit for service.

Performance and reliability of aviation gas-turbine engines in the past have been generally satisfactory and in most cases beyond expectations. In the future, proper planning, research and development will undoubtedly bring forth engines that are superior from the standpoint of fuel economy as well as flight safety.



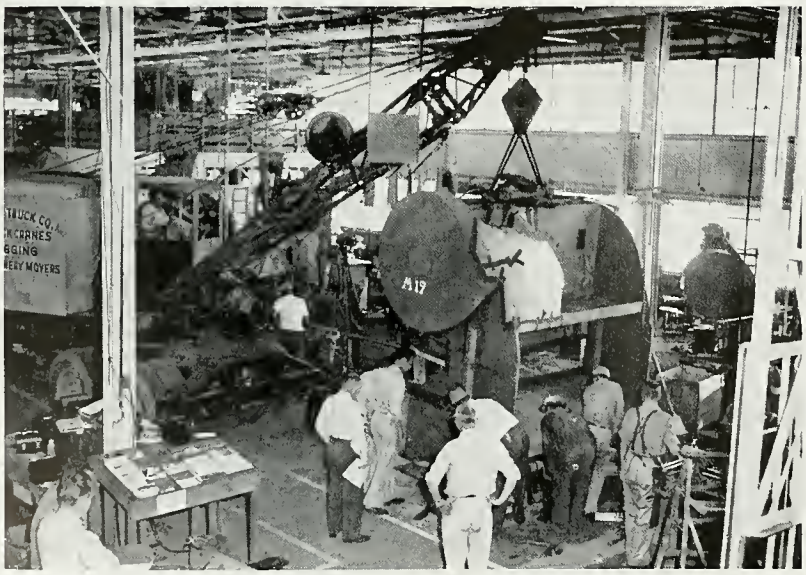
New equipment in Ryan plant

The big squeexe is on. A mass of machinery is moving into the Ryan plant to occupy every available square foot of production space. Ordered months ago, these new machine tools are arriving almost daily to speed Ryan's schedules for building the jet engine parts, rockets, airframe components and exhaust systems needed by the defense program.

Steel-hatted construction workers, with swinging-boom cranes and portable pile-drivers are commonplace among Ryan employees in the factory. Typical tools which they are installing are the Warco press (pictured below) and the bank of five Sciaky welding machines (above) which are being pressed into service to build more jet engine parts.

Smallest of four new presses, recently arrived, the Warco is being used to blank out stainless steel sheets for combustion chambers. The Sciaky welders will be employed to fabricate G-E jet components including combustion chambers, transition liners and exhaust cones.

Ryan now has more than fifty resistance welding machines, including some of the largest of their type and will soon have twenty more—now on order. As machine tool bottle-necks are widened, mills, lathes and heavy presses will flow into the remaining factory spaces.



CHIMNEYS FOR JET ENGINES

(Continued from page 13)

and beaded stiffeners are seam welded on each end. Special tabs, which are adjustable, are bolted on the exit orifice to vary the cross-sectional area. When the pods are installed, these tabs are used to equalize the thrust between engines.

A larger tab is built into the B-47 nozzle, which is automatically controlled by hydraulic actuater. When the pilot uses water injection, to obtain maximum power from the surging jets, this tab moves into the gas stream to accelerate the flow with furious force. Thus, the nozzle is utilized to glean a final spurt in speed.

From the nozzle assemblies, the pilot checks engine performance. Thermocouples, attached to the nozzle, flash a continual message of gas temperature to the cockpit. Variation in engine operation is instantly indicated by these readings.

The Boeing B-47 Stratojet has ushered in a new era of transonic combat. The Convair B-36 has dwarfed all previous conceptions of aircraft design and revolutionized global strategy. Now, the versatile Chase transport is harnessing the Bell pod to demonstrate its facility in a short-field cargo-carrying aircraft.

In these applications, it has been possible to place tremendous power at the disposal of the aircraft by simply attaching the engines to the wings of the planes. Undoubtedly, the development of the compact, streamlined pod built by Bell has marked a new trend which will see more power plants "flying" in the airstream under the thin wings of high performance planes.

YOU CAN'T PARK THERE!

When Maj. Robert L. Stimson, of the 49th Infantry Division, California National Guard at Stockton, Cal., had official business to transact at the Arcadia, Cal. National Guard armory, he simply landed a Ryan L-17 Navion on the Santa Anita race track parking lot right across the street.

Stimson didn't think there was anything unusual about use of the parking lot for a landing strip, but Arcadia Police Capt. Eric Topel had different ideas.

He was about to give Stimson a ticket when the flier, having completed his transactions at the armory, took off for his home field.

SLICK LIFTMASTER

(Continued from inside front cover)

are channeled to one location on the outboard side of the nacelle where the flaming exhaust gases are ejected to the atmosphere. Great care was exercised in the design of the triamese sections to prevent the overlapping of valve action between the integrated cylinders. This could allow the gases escaping from one cylinder to exert a back-pressure which would reduce the efficiency of another.

The DC-6 manifold design has distinguished itself by an outstanding service record. Originally intended to provide good service for at least one period between engine overhauls, this system has consistently rendered trouble-free service for extended periods of between 4,000 and 5,000 hours.

SINCE 1945, airfreight movement in the U. S. has increased some fifty times, while airline passenger traffic has little more than doubled. To meet the growing importance of airfreight, the Douglas DC-6A Liftmaster became the first plane in the world to be designed specifically for the carriage of commercial cargoes. The result of many years of study and research, it carries a 30,000-pound payload and has a cubic capacity larger than that of a railroad box car. The Liftmaster presents the latest innovations designed to accomplish the fast, efficient, economical transportation of goods by air.

Two enormous loading doors, one forward of the propellers, and the main door to the rear of the trailing edge of the wing, afford simultaneous loading and off-loading. These doors are unusually large. The main door is 10 feet 4 inches wide by 6½ feet high, and the forward cargo door is 7 feet 7 inches wide and 5 feet 7 inches high. Both doors are hinged at the top and swing upward to be clear of loading equipment.

A self-powered loading elevator can be installed to lift 4000 pounds from truck-bed height to the cabin floor level. The loading platform may be attached at either the front or rear cargo door, and folds up for storage at the rear entrance.

Perhaps one example demonstrates the importance of modern airfreight and how markets for specialized products are tremendously expanded by having 315 m.p.h. cargo shipment available.

As a result of airfreight, the San Francisco flower industry has increased its fresh-cut flower shipments to New York from 10 million to 50 million dollars in the past five years. Because the cargo space of the new DC-6A is pressurized, it permits absolute temperature and humidity control for maximum preservation of flowers and forecasts the development of many new, distant markets.

First scheduled DC-6A freight flights were started between New York and the West Coast this past spring by Slick Airways. Leaving New York just before midnight, which gives customers plenty of time to get shipments to the airport, the Liftmaster arrives in Los Angeles in time for downtown deliveries before 10:00 o'clock in the morning.

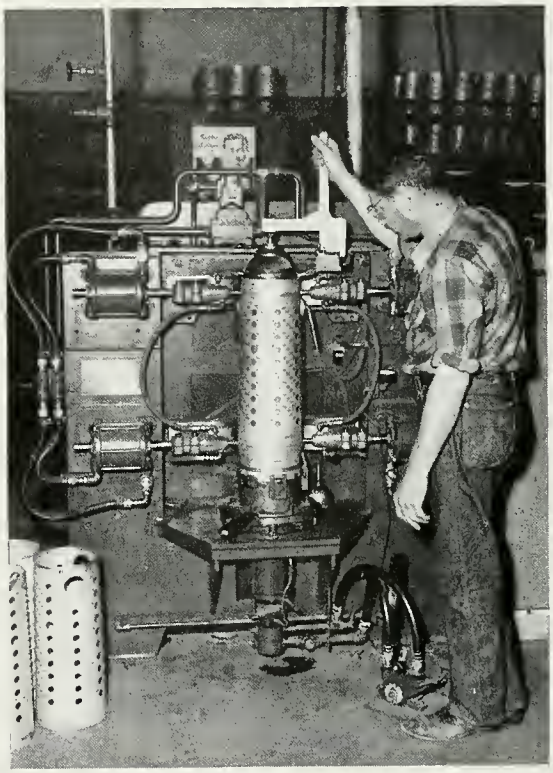
"When our fleet of six DC-6A Liftmasters are all in operation," says Thomas L. Grace, Slick president, "our cost for long hauls will be reduced appreciably, because this plane was designed to haul freight at an economical cost per mile."

"FOUR IN ONE BLOW"

One of the most specialized welding machines ever devised has recently been installed at Ryan Aeronautical Company for use in production of jet engine components. Designed by the Thomson Welding Machine Company, this new metal "stitcher" is tailored to perform an unique operation on a single type of Ryan jet component. It makes four simultaneous spot welds.

Described as a "post spot-tacking machine," this unusual tool serves as both an assembly and fabrication machine in the manufacture of inner combustion chambers for the General Electric J-47 jet engine. It quickly aligns the three major parts of the combustion chamber and spot-tacks them together prior to seam welding.

Most striking feature of the machine is a brass and copper tool, or arbor, which serves double duty as an alignment tool and a central electrode. At the top and bottom of the arbor there are expanding sections consisting of four pie-shaped segments. The movement of a tapered pin, actuated by an air cylinder, expands these segments into the assembly. Four horizontal electrodes move simultaneously against the expanded sections to discharge their welding current.



In operation, the combustion chamber shell, exit shell and cap are placed on the arbor. With a touch of a foot switch, the expanding sections move outward, bringing the assembly into exact alignment and concentricity. Another foot control causes the electrodes to move in and fire, making four spot-tacks at each impulse. The assembly is rotated, automatically, so that a total of 32 spot-tacks can be accomplished in eight swift rotations.

The new machine saves time and effort and eliminates the need for an extra employee. Previously, the assembly of this structure required two employees: one to assemble the parts in a jig and another to hold this unwieldy jig in a spot welding machine while single spot welds were made. Because of the necessary weight of the jig, this operation was fatigue-producing. Then, the assembly had to be removed from the jig.

The Thomson post spot-tacker eliminates this handling and effort by aligning the parts, spot-tacking them and releasing them in one set-up which is relatively effortless. One machine operator can assemble the combustion chambers five times as fast as two employees could formerly accomplish the work. Because of the satisfactory performance of the new equipment and the increasing orders of G-E combustion chambers, Ryan is acquiring another machine of this uusual design.

RYAN AERONAUTICAL TO EXPAND ROCKET MOTOR WORK TENFOLD

A ten-fold increase in production of complete rocket motors for surface-to-surface missiles will be undertaken by Ryan Aeronautical Company as a result of orders just received, T. Claude Ryan, president, has announced.

Latest contract for missile rocket motors is from Firestone Tire and Rubber Company of Los Angeles. Previously Ryan has built rocket motors under contract with Douglas Aircraft Company for an Army Ordnance Corps missile which has been developed under the direction of the Jet Propulsion Laboratory of Caltech.

To confine the tremendous but short-lived thrust of the powerful rocket engines, extremely heavy gauge materials are used in the manufacturing processes, which require new techniques in forming and welding. The engine consumes vast quantities of fuel and oxidizer, creating terrific internal pressures.

Drop-hammer forming to very close tolerance is used by Ryan in fabricating the outer shell and other sheet metal portions. Both electric resistance and arc welding processes are used, as is furnace brazing, in joining the various components. Certain of the major assemblies of the motor are precision machined from stainless steel billets.

Long experienced in building the "hot end" of jet and piston engines, Ryan is further expanding the scope of its interest in the rocket motor field as the result of the new Firestone contract.

NAVION CUSTOMER CHECK-UP

(Continued from page 9)

ately at the service shop and those which can be accomplished at the next period check.

The final part of the inspection consists of a flight check on the ship, with the owner riding as co-pilot while we put his Navion through a thorough operational flight. Starting procedures, ground handling, take-off and climb power settings, cruise control, slow-flight, and emergency procedures are carefully reviewed with each owner. If there are any questions about maximum performance for short take-offs or landings, they are demonstrated on the spot in the owner's own airplane. Following the flight, Balch carefully answers any questions the owner may have regarding maintenance, operation, or service for the airplane. By getting the word directly from the "horse's mouth," his confidence in the airplane is increased tremendously.

Nor is the owner the only one who benefits from the clinic. Service managers and shop personnel from each dealer or distributor are briefed on latest maintenance techniques for both the engine and airframe.

Ideas for better maintenance and airplane utilization are passed on from one section of the country to another and demonstrated by the team. The revenue brought into the shops because of recommended work or improvements to individual airplanes is no small factor, and the renewed relationship between owners and dealers is often the basis for additional work and better service.

On most of our tours we're accompanied by L. J. Holland or Bob Tinney of Continental or by Pete Gailey of Lycoming. Their on-the-spot adjustments for malfunctioning and other services often mean days or weeks saved in getting warranty adjustments for the customer. A good bull session with the pilot generally can clear up any misunderstanding. Correspondence and phone calls never have done the job that personal contacts do in a few minutes.

On the face of it, it appears that Ryan is shelling out a lot of stockholders' money for a free courtesy service to Navion owners, with no prospect of financial return. On the contrary, the team has picked up an invaluable amount of knowledge concerning the Navion, sales potentials, and owner reactions which will be handy to have on tap. Inspection sheets are carefully analyzed to find recurring weaknesses in the product which will result in a much better airplane. The public relations aspect alone has proven to the flying businessmen that Ryan is standing behind its product, and dispels recurring rumors of the possibility of the ship becoming an orphan during the emergency.

Successful completion of this year's clinic has been no small job. The schedule for the entire year was laid out in March. The statistical results to date are a tribute to the dependability of the business airplane of today. Although traveling more than forty thousand miles in eighteen weeks, the team has not missed a single appointment—and has lost only one and a half day because of weather—and all of our flying has been contact!

By holding clinics in 41 major cities in nearly every state in the union, we have checked a total of more than six hundred airplanes since April. In addition to the ground inspections, flying time has averaged better than thirty-five hours per week, including ten to twelve test hops per day and cross-country flights in the company's Super 260. On our rare and infrequent trips to California, we spend our time raising kids and petunias, all of which are doing nicely, thank you.

The value of Ryan's courtesy clinics is bound to have a far reaching effect not only on today's flying businessman, but on the post-emergency sale of airplanes. Despite the pressure of military demands upon the industry to take care of war equipment, this idea of service will pay off in happy customers when the production lines again start turning out business planes.

Ooops!

Wheels down or up—it's all the same to a Ryan Navion for smooth landings.

At least, so vouches a Texas pilot who had glowing praise for his Navion after an unusual experience recently. But let the embarrassed but nameless pilot tell it:

"May I compliment you on building a really rugged and safe airplane. Last week, I made a wheels up landing on the Municipal Airport at Little Rock, Arkansas.

"I had with me my wife and 8-year old daughter, who was sleeping 'thwartship' on the rear seat. There was very heavy traffic—an airliner holding on one of the runways, and military planes landing on another runway.

"I neglected to drop my wheels and came in on the grass to the right of a runway. I did, however, use full flaps. My wife was not aware that we had made a belly landing until after we had come to a stop. My daughter wasn't even rolled off the back seat. In fact, she was not even awakened, but slept through it all.

"Last, but not least, we jacked up the plane, dropped the wheels, installed a new propeller, and took off for home. No other damage except a bent step and a deflated ego."

TITANIUM DEBUT

(Continued from page 11)

is the answer to many of the aircraft designer's problems. For years, engineers have been forced to specify heavier steel alloys in the design of structures which required more strength than aluminum alloys could provide at elevated temperatures. Because the aluminum alloys lose strength rapidly at temperatures above 300°F., this meant that a wide variety of components, such as fire walls, ducts and shrouds, had to be built of stainless steel.

Titanium retains its exceptional strength up to temperatures of approximately 800°F. It weighs only 56 percent as much as steel and approaches the best steels in strength. Some titanium alloys can now provide 175,000 p.s.i. tensile strength and new types with 200,000 p.s.i. are being developed. With a lower linear coefficient of expansion and thermal conductivity than either aluminum or steel alloys, titanium is the only metal known to have an endurance strength consistently in excess of 50 percent of its tensile strength.

In research at Ryan, flat sheet was formed to a complex-shape to shroud the high temperature exhaust system which Ryan builds for the Piasecki HUP-1 helicopter. Since this component operates at a temperature of 400°F. it appears to be an ideal application which combines the weight-saving and heat-resisting qualities of the metal. However, little information was available on the production forming of titanium, due to the fact that it made its commercial debut in 1946 and only 60 tons of the metal were refined in 1950.

Ryan established an experimental production procedure to determine the behavior of titanium when welded, formed and heat-treated. The effectiveness of cold forming plus annealing and of hot working were determined on sample strips of .018" material. Quantitative evaluations of the ductility of the metal using various annealing and pre-heat treatments were obtained. These experiments indicated that either alternate cold forming and annealing or hot forming of titanium would be feasible. The metal should be deformed at temperatures between 800°F. and 1,000°F. with optimum formability at the higher temperature. Lead or Kirksite forming dies are not practical because the metal picks up the die material. Steel or cast iron dies should prove satisfactory.

Controlled atmosphere furnaces should be used to prevent the formation of scaling during heat treat. Scale was satisfactorily removed at Ryan by placing the parts in a descaling salt bath of sodium hydroxide and sodium nitrate at 850°F. for five minutes. After rinsing, they were dipped in a cold pickle solution of nitric acid and hydrofluoric acid to remove the oxides which formed in the salt bath.

Good spotweld results were obtained, in spot welding titanium to itself, with machine settings which produced penetrations from 70 percent to 90 percent. Shear values were approximately 650 pounds for the .018" commercially pure titanium and 1300 pounds for .037" combinations. No success was experienced in spot welding titanium to other metals.

Although discovered back in 1791 by an English clergyman named Gregor, titanium was not produced commercially until 1946 when William Kroll, U. S. Bureau of Mines engineer, evolved a process for separating it from its ore. A clue to the tremendous affinity which titanium has for other substances can be gleaned from the fact that the ore can be purchased in the market at only two cents a pound but the refined metal costs from $10.00 to $20.00 per pound. Major sources of the metal, which is still produced on a very limited basis, are Titanium Metals Corporation of America and Rem-Cru Titanium, Inc. Another company, Horizons, Inc. is hard at work on a new process for refining titanium which promises to reduce its present production costs by 80 percent.

Greatest immediate use for titanium and its alloys will undoubtedly be in the formation of aircraft "skins," or surfaces, for supersonic planes. Friction induced heat is now zooming temperatures of these high speed aircraft to well above aluminum alloy's limits. Titanium could handle these critical temperatures with ease and buoyancy.

Keenest disappointment which titanium has caused metallurgists, who looked with relish upon its 3150°F. melting point and hexagonal crystalline structure, is its inadequacy to withstand continued temperatures above 1,000°F. For short periods, titanium behaves beautifully. At exposures to 2,000°F. flames, aluminum plates disintegrated in less than one minute and titanium showed no adverse effects after 30 minute exposure. Upon cooling to room temperature, it had regained its typical annealed strength.

HOWEVER, under continual temperatures of more than 1000°F. titanium suffers an irreversible absorption of oxygen and nitrogen which rapidly reduces its ultimate and yield strengths and causes it to become brittle. If this deficiency could be overcome, so that titanium would remain useful up to temperatures of 1600°F., a whole new field of applications would be uncovered. Combustion chambers, inner and outer cones, tailpipes and transition liners for jet engines would use large quantities of the metal.

Ryan development engineers and metallurgists are working on this avenue of research which falls into Ryan's extensive experience with high temperature applications. Because titanium's deterioration at continued high temperatures appears to be due to events which occur at the surface of the metal, great hope is held for its future in these hot spots if something can be done to protect its surfaces against oxidation and absorption. Ryan metallurgists are experimenting with new ceramic coatings on titanium to determine the success of these materials which have been so beneficial in preventing the oxidation of stainless steels at very high temperatures. The outcome of these important evaluations may have an important influence upon the employment of titanium in these specialized fields.

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D-17 flanges are precision turned on vertical turret lathe. This exhaust cone converts G-E J-47 turbojet into afterburner version with added kick.

ON THE COVER

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RYAN BRACKETS THE AIRCRAFT FIELD

Ryan SINCE 1922

AIRCRAFT and AERONAUTICAL PRODUCTS

Pilotless Aircraft
and Jet Propulsion Research

Electronics Research
and Development

Ryan activities bracket many fields ranging from development of subminiature electronic equipment to manufacture of huge external fuel tanks and fuselage sections . . . from executive-liaison planes to high-speed pilotless jet aircraft and new applications of jet propulsion.

RYAN AERONAUTICAL COMPANY
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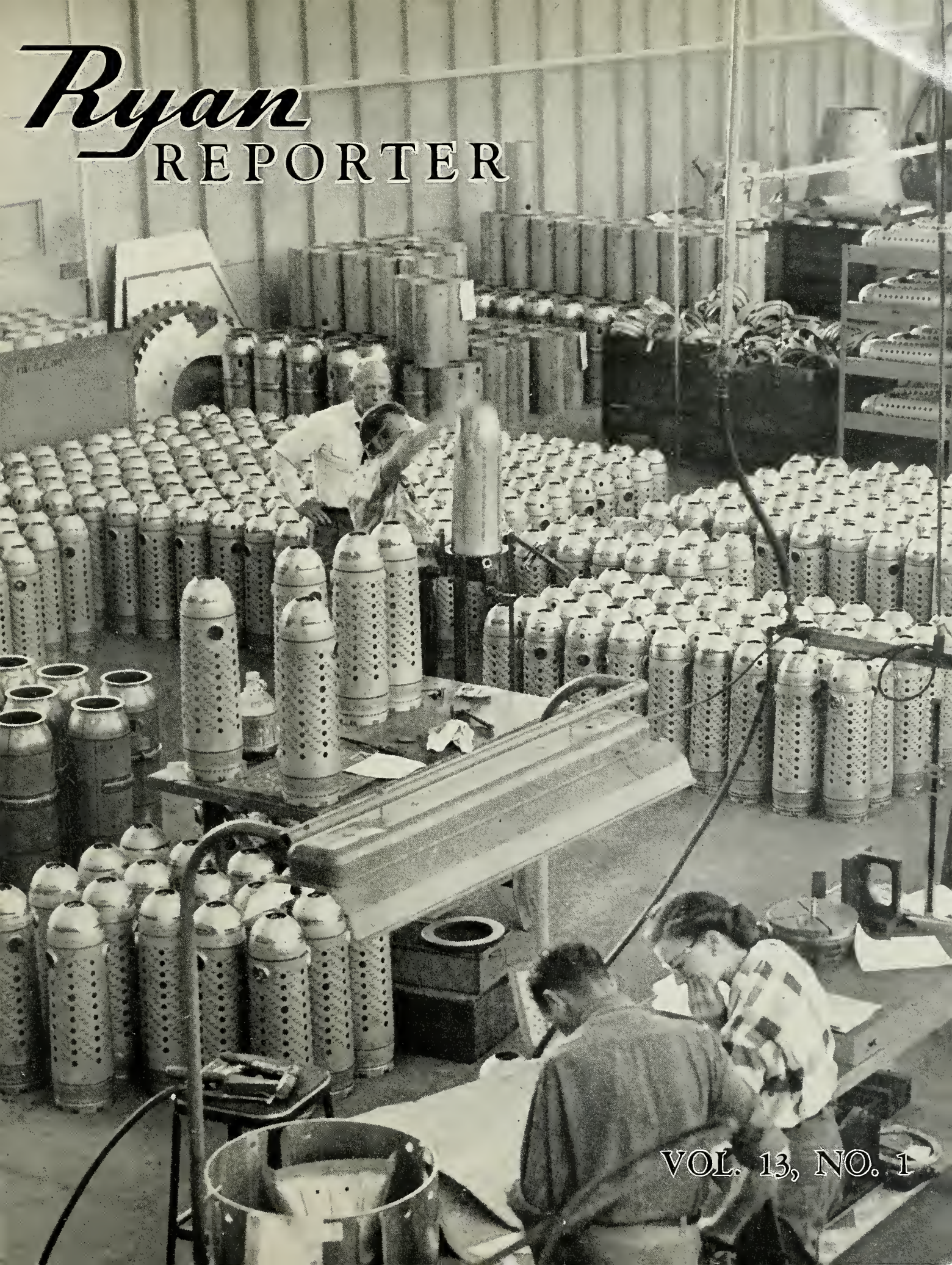
Ryan REPORTER



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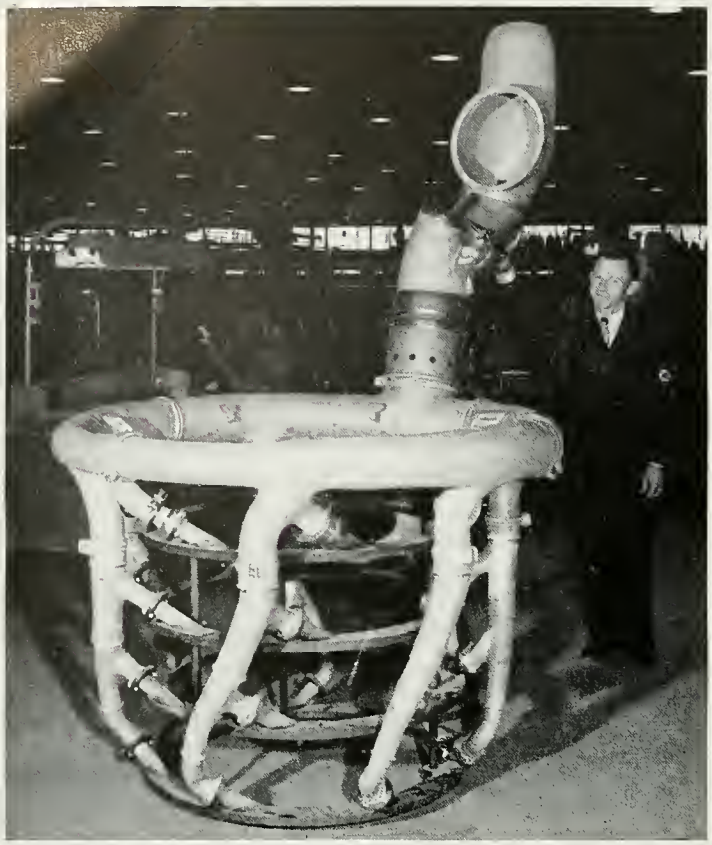


Fire control for a Wasp Major. This Ryan manifold is the first designed to harness waste horsepower in commercial application.

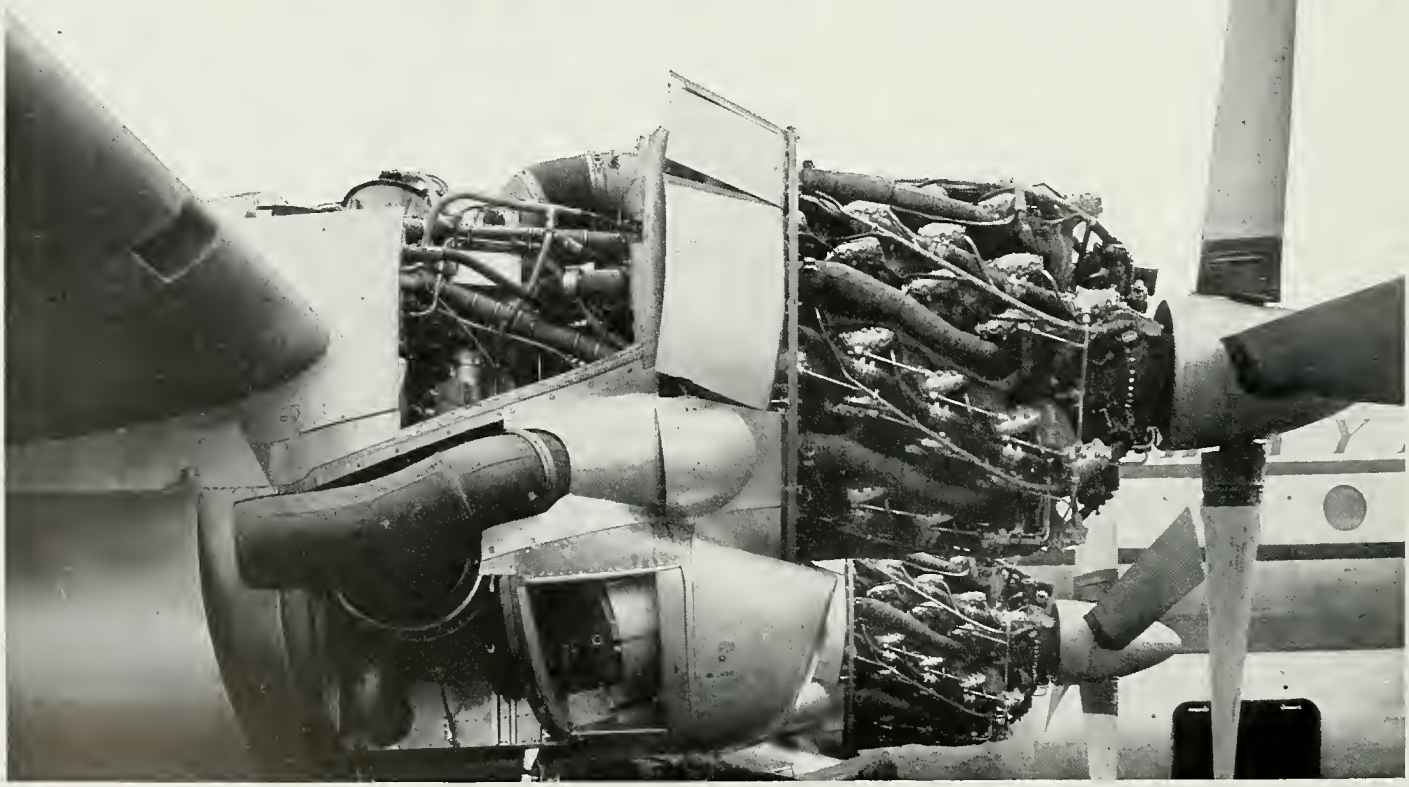
By A. W. WHITE

Aircraft Gas Turbine Department

General Electric Company

Based on a Paper Originally Presented
Before the SAE National Aeronautic Meeting, New York

TURBOSUPERCHARGERS FOR



Turbo commercial debut was made in Boeing 377 Stratocruiser power package in 1949. Note Ryan exhaust system nestled in nacelle.

AIRLINERS

THE advantages of high-altitude flying, proved by turbosupercharged military bombers and transports during the war, led the Boeing Airplane Company to use the first turbos for commercial airliners on their luxury double-deck Stratocruisers. Placed in inter-continental service in 1949, these four-engine, seventy-five passenger aircraft have flown over 20,000,000 airplane miles, including more than 5,000 ocean-crossing and 2000 trans-continental flights.

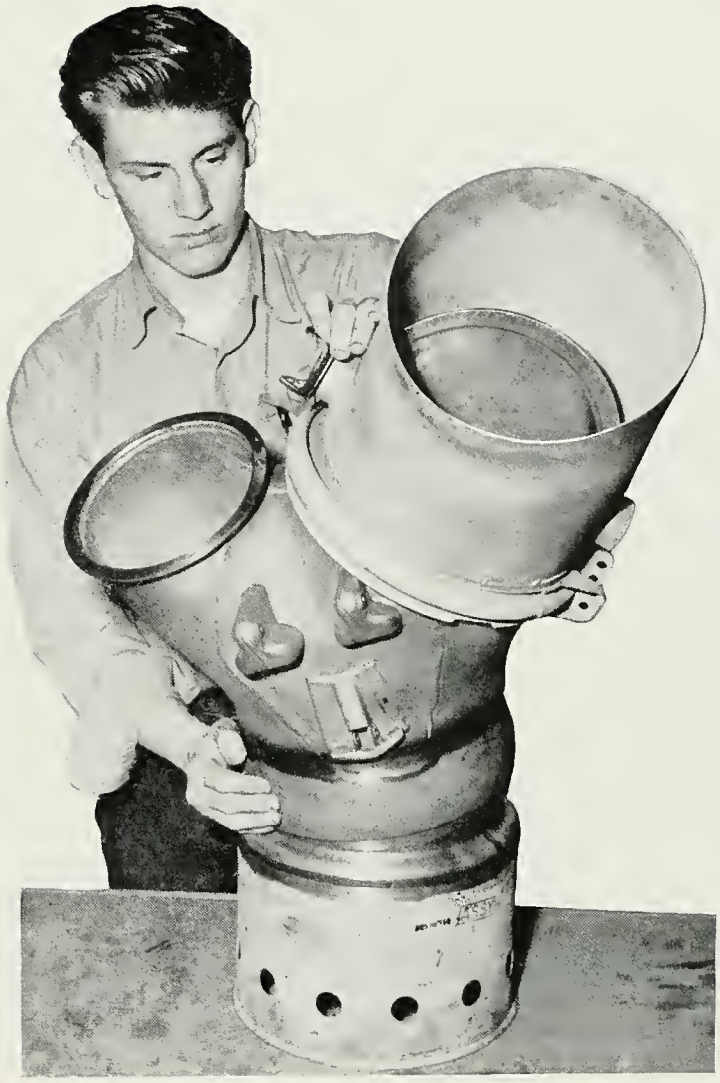
Each Stratocruiser employs four General Electric model BH4 turbosuperchargers to attain its more than 300 miles per hour cruising speed and maximum operating altitude of 25,000 feet. A total of over 1,000,000 hours has been accumulated on the BH4 turbos in the Stratocruisers, with one unit accumulating 3657 hours—or the equivalent of five months of continuous service.

In general, superchargers are of two types; turbosuperchargers and mechanically-driven, geared superchargers. The BH4 is a turbosupercharger or gas-driven air compressor, which is capable of doubling the horsepower of a piston engine at high altitudes. It is superior in effectiveness to the geared supercharger because it utilizes the energy from waste exhaust gases rather than subtracting power from the engine itself to drive the supercharger.

In the operation of the BH4 turbo power plant, hot exhaust gases, resulting from the combustion of the fuel-air mixture in the cylinders of the engine, are fed to the nozzlebox of the gas turbine through the airplane's exhaust system. These expanding gases pass through the nozzles and strike the buckets of the turbine wheel, giving it a high rotational speed. The turbine wheel is mounted on a shaft connected to a compressor impeller. As it spins, it turns the impeller at high velocity. After the gases have passed through the wheel, they are discharged into the slip-stream.

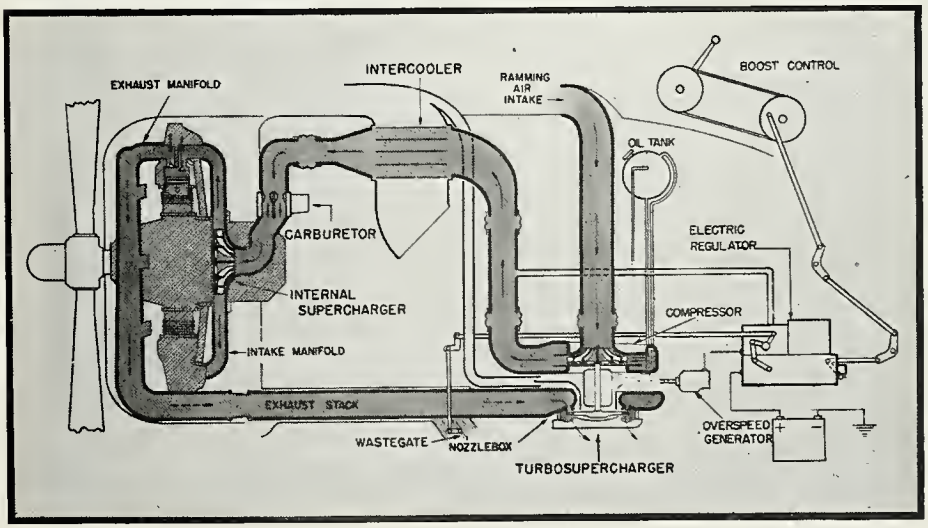
Outside air enters the induction system through the ramming-air intake. The air passes through the induction system to the inlet of the centrifugal compressor. Discharged from the compressor casing, it goes to an intercooler, where the heat of compression is removed. Cooling of the supercharged air is neces-

(Continued on page 16)

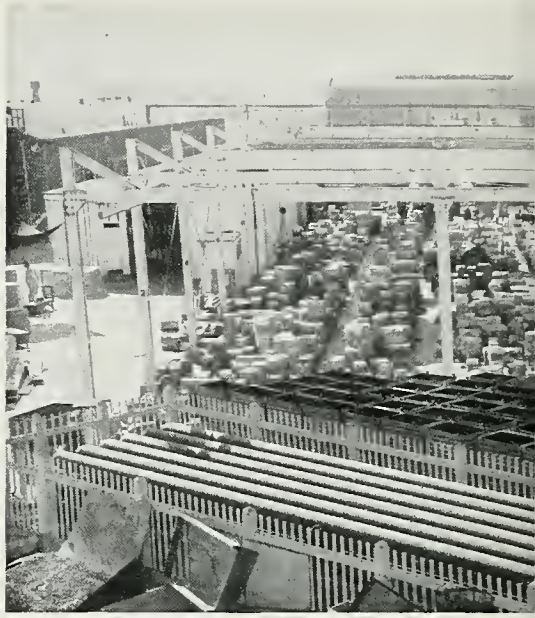


Ryan turbo take-off section is prepared for shipment by Charles Swanson. Fabricated from stainless steel, it incorporates a wastegate valve of Inconel X. Controlled by automatic means, the valve diverts escaping exhaust gases to the turbosupercharger.

Schematic drawing illustrates how ram air is compressed by turbo, cooled, mixed with fuel, compressed by another supercharger and fed to cylinders. Exhaust blast powers turbine of turbo. Automatic controls maintain constant carburetor pressure settings.



Newly paved areas near railroad spur track in front of Ryan factory provides storage space for great quantities of stainless steel sheets being used in increasing volume.

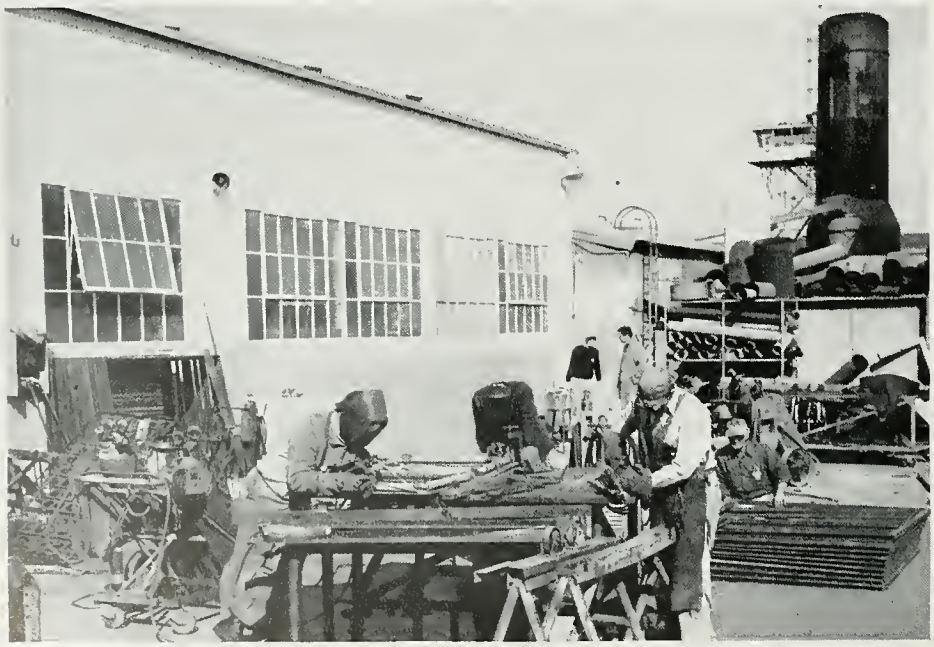


Foreground: Oxygen is piped into plant for weld ing from these giant cylinders stored outdoors

300,000 Under

Factory work goes on outdoors

Welders of the Ryan maintenance department can work outdoors most days of the year while repairing equipment and performing similar tasks under sunny California skies.



IF YOU'RE an aircraft worker and lucky enough to live in California, you know that you don't need a roof over your head at all times for factory tasks.

At Ryan Aeronautical Company in sunny San Diego, for instance, of the more than one million square feet of working space, almost one third is in the outdoors.

This expanse of 300,000 square feet under the sun is devoted to a multitude of purposes. Near the railroad spur track, large paved slabs provide outdoor storage space for thousands of sheets of stainless steel. And because the climate is generally so mild, many parts still in process and in transit from one department to another, are stored outdoors in bins, racks and carts, saving valuable indoor areas for actual production work.

Another blessing of the vast outdoor. fenced-in areas is their availability for storage of dies, jigs and fixtures which for the time being are inactive but may some day again be needed. A stockpile

onorail crane is used to move production dies enter) into nearby drop hammer department.

Feet the Sun

ear 'round at Ryan

There's plenty of room available for storage of manifold exhaust assembly parts in area between Ryan's main factory building, shown at right, and paint shop, at left.

of various sizes of pipe required for installation of gas, water and air lines is maintained in the open.

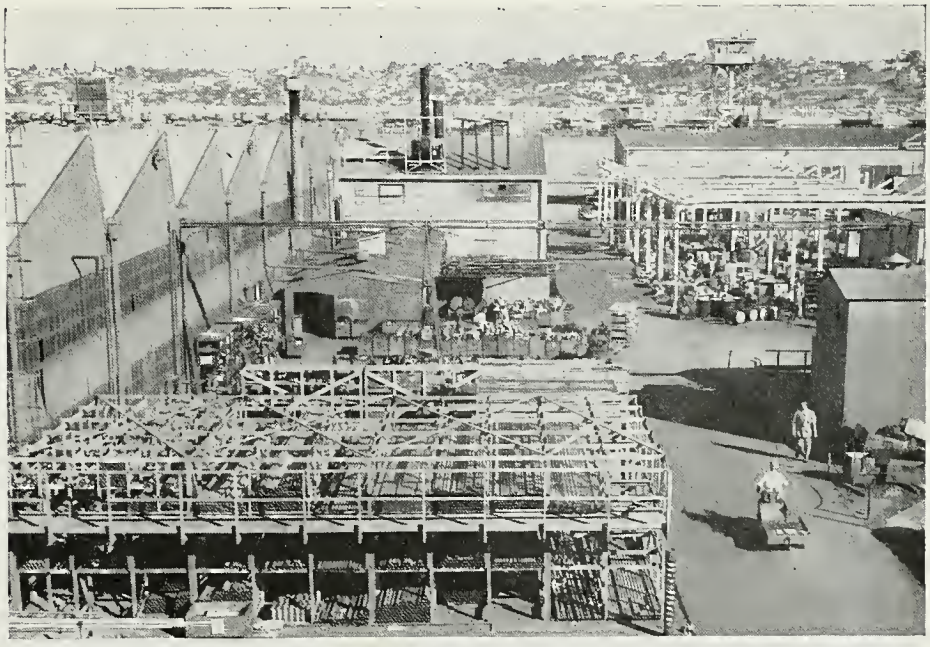
In another area, maintenance welders are busy with their torches. Elsewhere, lumber is being salvaged for re-use in packing crates, office wall panels, etc.

Ryan's paved outdoor working area is being constantly expanded as the need arises. Each square foot that can be utilized under the sun releases space inside a factory building for heavy machine tool tasks.

Because servicing of Ryan Navion planes can be performed to a great extent outside, a comparative minimum of enclosed hangars is required. Mechanics often can perform their jobs in nature's air-conditioned plant.

Not many years ago the very land on which implements of national defense are being built at Ryan was beneath San Diego Bay. Lindbergh's conquest of the Atlantic in a Ryan plane built in San

(Continued on page 19)



Stainless steel tubing is racked outdoors in foreground. At upper right are dies, and in center of photo is area where manifold assemblies still in process are accumulated.

Arabian American Oil Company's fleet of Navions has demonstrated rugged features in desert operations. Planes have been used since 1947 in all types of missions.

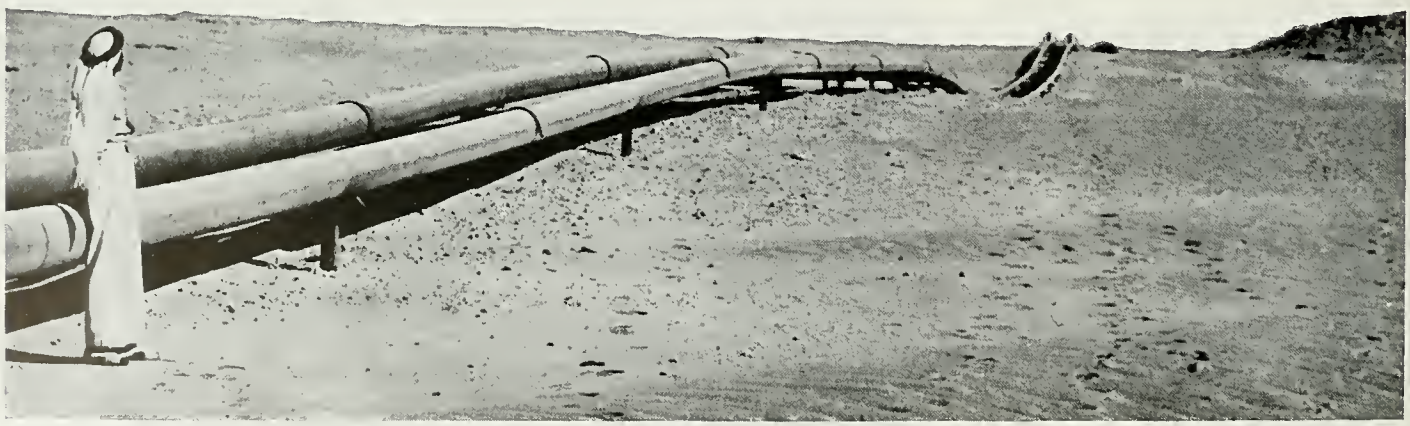
NAVIONS in the DESERT

by Capt. M. H. Platt, Arabian American Oil Company

FIVE sleek new Navions were uncrated and assembled at Dhahran, Saudi Arabia, in 1947 for use by Arabian American Oil Company (Aramco). They had come by ship from America and as airmen and engineers looked them over, there was a great deal of conjecture as to whether or not these planes could stand up under assignment in some of the toughest desert country in the world.

Proven aircraft had been used in this kind of country before. The Navion, however, was a new design with changes that had converted the usual slow, light plane into a smaller equivalent of the most modern flying equipment then in the air. Its worth would only be determined by hard use, for between the thickening traffic of Aramco's motor vehicles on the ground and the fleet of DC-3's in the air, there had developed a wide gap that could be effectively filled only by smaller planes.

Besides the reason of economy, which always plays an important part in selection of aircraft, Aramco had reasons lined up which were just as important. For one thing, the headquarters town of Dhahran was beginning to appear as the hub of a giant wheel of operations. Spoke after spoke was being added to the wheel as exploration teams set out on geology, mapping, surveying and structure drilling projects. Fast air transport of personnel and materials for such parties was be-



coming normal procedure. Where there were airfields, usually the landing strips could not handle aircraft larger than the Navion.

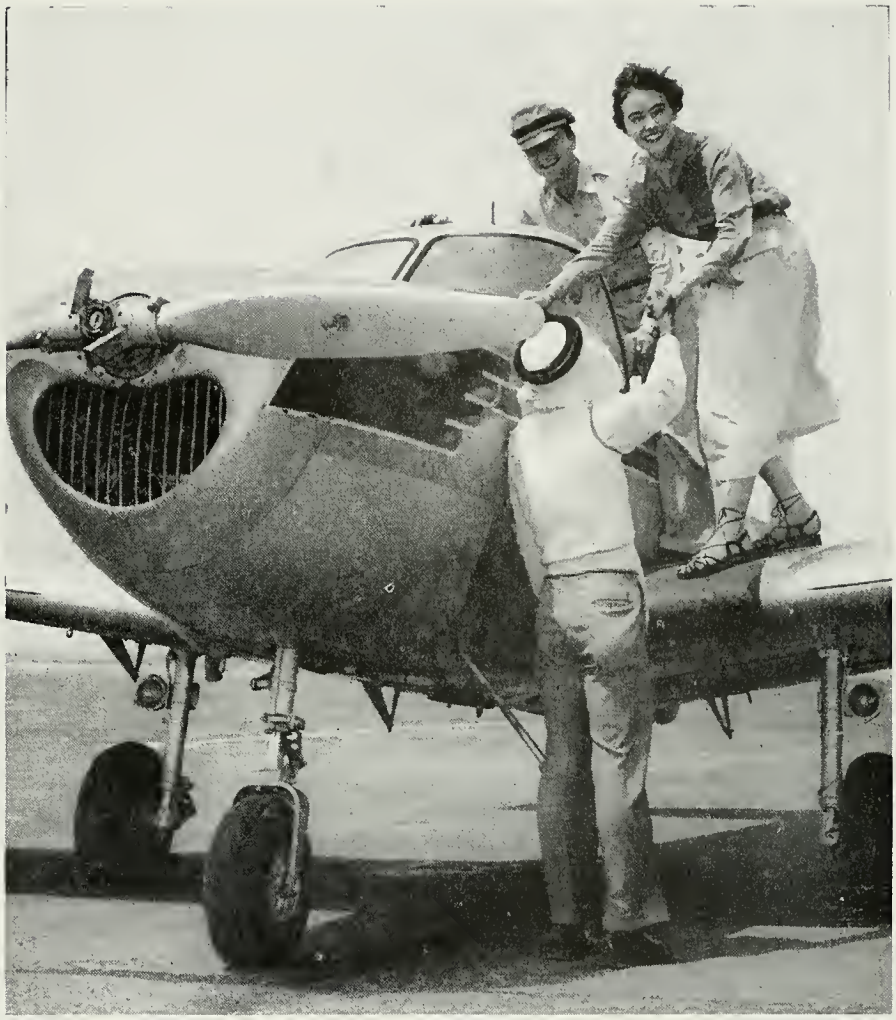
Also arising was a real need for aircraft with reliable maneuverability at slow speeds; planes to handle pipeline patrol and search flights.

Search flights and emergency rescue work are jobs the Navions perform very ably. Many a lost person has spent the night between comfortable sheets instead of on an anticipated mattress of sand because of the effectiveness of the Navion as a search plane. And because of this very effectiveness, the Navion was part of a fish story too—for it was used on one occasion just offshore in the Gulf to locate schools of fish in an Aramco-sponsored project. Nor is it too unusual for Aviation to get a call: "Man hurt. Bring doctor as quickly as possible. No airfield; will have to land on road."

In such life or death emergencies, Navions have sped to the scene, and after careful inspection of the landing point, have brought in the needed help—in most cases all in a matter of minutes.

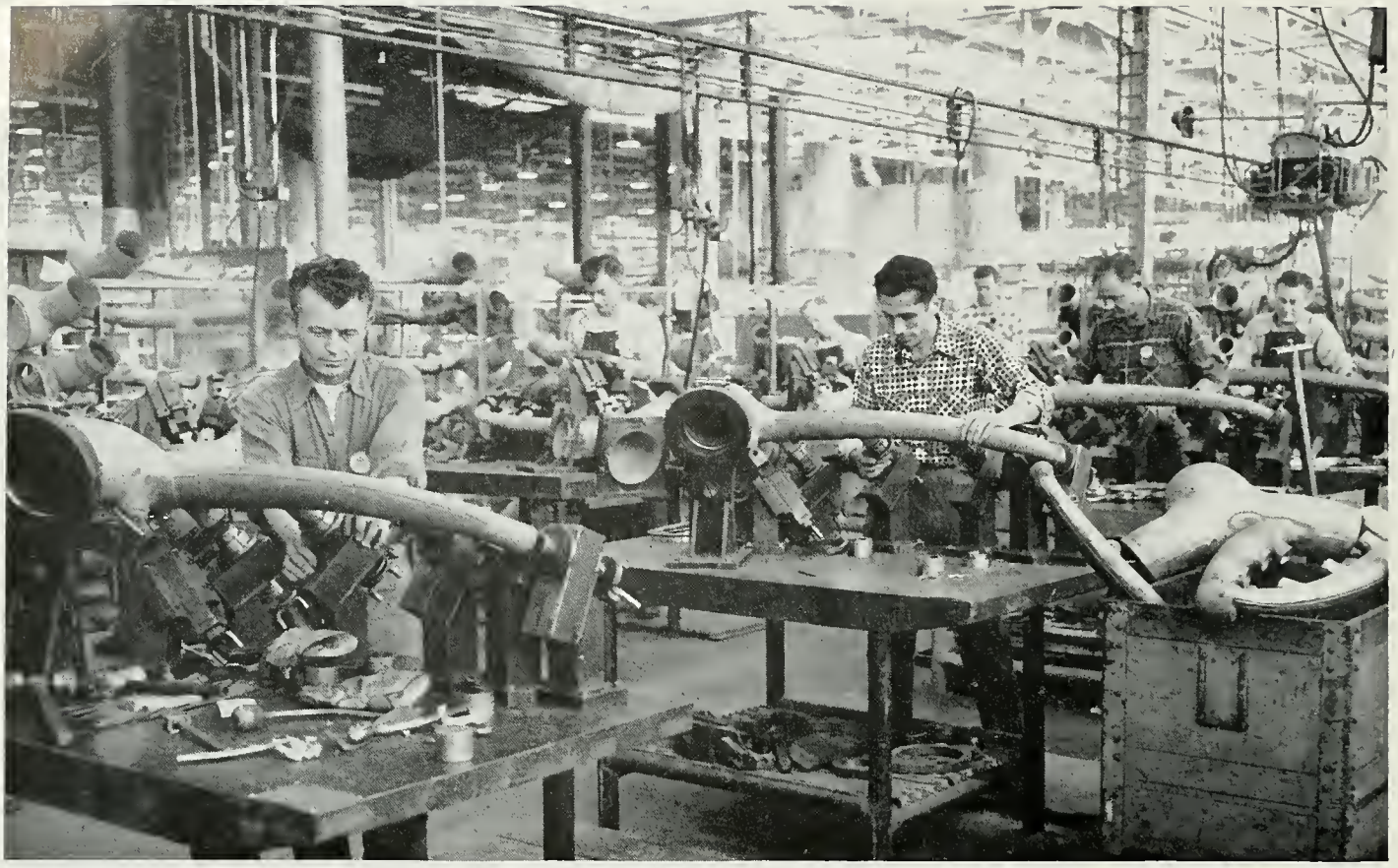
Right now, too, the trans-Arabian pipeline system is patrolled almost 1100 miles with Navions. From Abqaiq, Saudi Arabia to Sidon, Lebanon, pilots keep a vigilant eye on the vast oil carrying system which feeds oil from Saudi Arabia's

(Continued on page 16)



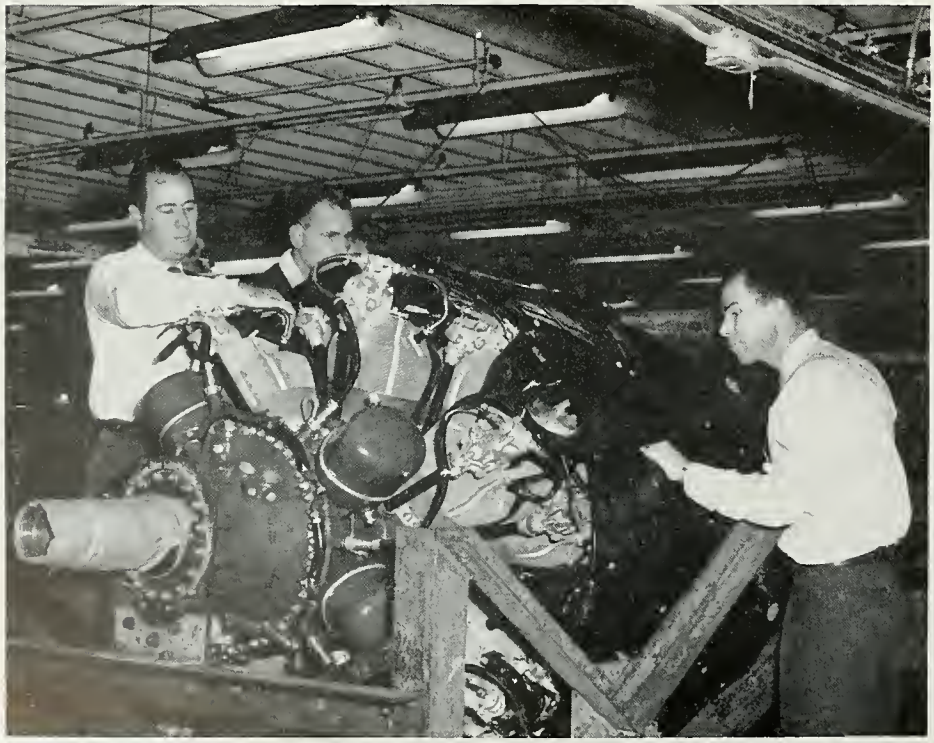
A girl employee at the Dhahran airport in Saudi Arabia is introduced to one of the Aramco Navions which are used to patrol 1100 miles of the trans-Arabian pipeline.

Navions and DC-3 share an Arabian American Oil Company hangar at the Dhahran Airport, Saudi Arabia. Aramco's fleet includes two four-engined DC-4s which span the Atlantic regularly, eight twin-engined cargo and passenger planes, and five of the Navions.



Gathering momentum, Ryan –59 production is rolling into high pitch. An expanding factory area is devoted to this prime program.

Integral Collector



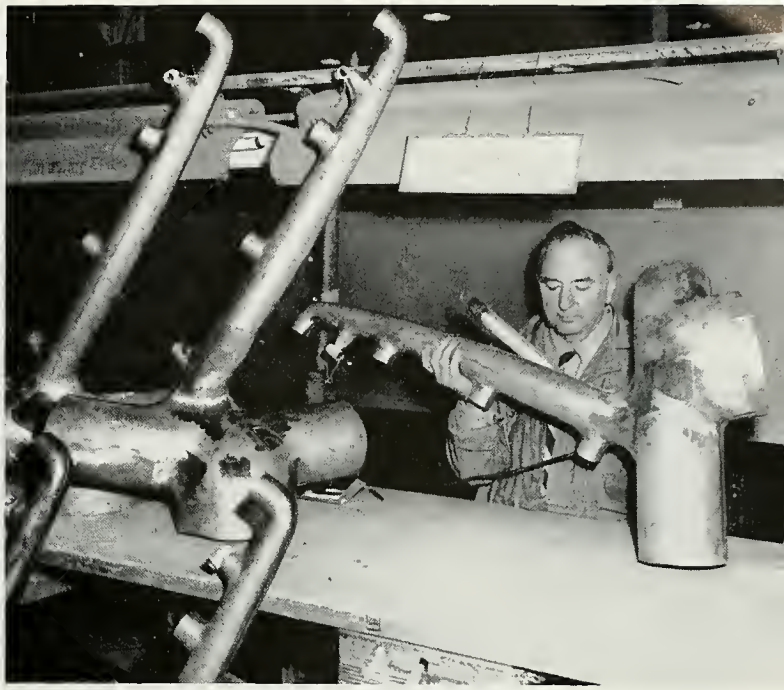
A LONG-SOUGHT objective in aircraft engine exhaust systems—an integrated design—has been accomplished in the manifolds Ryan is now building in quantity for the 3500 h.p. Pratt and Whitney Aircraft R-4360-59 Wasp Major engine.

The first design for large horsepower piston engines to incorporate the collector ring segments and cylinder header sections in integral forming, the -59 exhaust systems are destined for use on Boeing C-97 and KC-97 four-engine Stratofreighters and Flying Tankers.

With only 14 major stampings, the big Ryan-built assemblies have fewer parts than any other high horsepower exhaust system. The combination of collector ring and header sections elimin-

(Continued on page 18)

Ryan engineers Ted Hacker, Bob Williams and Frank Hughes check newest model of R-4360 engine. Their findings will be used in development of tailored designs



Under the experienced eye of Arthur Bunch, –59 welded seams are carefully scrutinized. Note smooth, flowing contours in metal achieved by Ryan forming techniques

Seams of big P. and W. headers are fused with Heliarc welding torch. Largest formed by Ryan, the stampings are made of 310 stainless steel.

Octopus-like –59 unit dwarfs Lab chief Bill Cockrell and engineer Ted Hacker. This one is ceramic coated for experimental testing.

E. M. Beattie, pilot, and Newell Davis, flight engineer, ready for take-off in the North American B-45 on loan from the Air Force.

ANSWERS in the SKY

The General Electric flight crew goes over flight plan and test program before flight. Manager of G-E Flight Test Division is C. G. Talbot, right. Others pictured with B-45 4-jet bomber are, left to right, Harry Etzel, co-pilot; Newell Davis and E. M. Beattie.

EXTENDING more than eight miles into the sky and covering an area of hundreds of square miles is one of the nation's most important laboratories. It is the General Electric Company's Flight Test Center, where specially equipped planes and highly trained engineering flight crews test aeronautical equipment under development by the company for the Armed Forces and others.

In addition to jet aircraft power plants, the closely guarded research center tests armament, instruments, autopilots, radar, electrical systems and electronics and communications systems *in the air*.

Part of the G-E General Engineering Laboratory, a highly versatile organization which for years has designed and built incredible electric instruments and devices, the Flight Test Laboratory operates a private "air force" base at the company's headquarters at Schenectady.

Included in the fleet are two North American B-45 bombers and a Lockheed F-94 fighter. One of the B-45s is used to check the service life of its four G-E J-47 jet engines under closely controlled conditions. Completely instrumented, this plane often flies to Boston, then to New

G-E's Flying Laboratory is always "up in the air"

York City and back to Schenectady, all within an hour.

The other B-45 is the nation's first jet-propelled "laboratory" to be placed in operation for high speed flight testing of turbojet engines of advanced design. The four-jet bomber carries a fifth test engine in a specially-designed nacelle under the bomb-bay. The bomber was assigned by the Air Force to the company to flight test new jet engines developed by the G-E Aircraft Gas Turbine Department at Lockland, Ohio, at speeds never before attained in such operations.

The F-94A is used to test automatic flight control equipment, along with two other planes — a Douglas B-26 and a North American B-25 — devoted to similar work.

Another "flying laboratory" is one of the world's highest-flying Boeing B-29 bombers. Some months ago, 100,000 spectators at an Air Force show in Washington were startled to see a huge Superfortress roar over the field with its four propellers stopped and sticking out like sore thumbs.

Then they noticed a torpedo-shaped object hung beneath its belly. The "torpedo" was actually a powerful jet engine which alone was propelling the huge bomber.

While hardly normal flight procedure, the purpose of the flight with jet alone was "to show vividly the tremendous power of a modern jet engine."

The huge "flying test bed" is usually flown with the four piston engines operating, to provide the altitude and speeds required to test the jet engine.

The powerful G-E J-47 jet, supplying more than 5,200 pounds of thrust, is retracted into the bomb-bay when not in use.

A radio and telephone hook-up with test planes enables engineers of the company's Aircraft Gas Turbine Department at Lynn, Mass., 150 air miles from Schenectady, to "sit in" while jet tests are under way. From their offices they help conduct the actual tests and receive first-hand reports of the results.

To determine how new equipment reacts under actual operating conditions, the planes are fitted with special photographic devices which record every phase of performance in the carefully prepared testing schedules.

Such developments as J-47 jet engine high-altitude starting, anti-icing and electronic control features, advanced autopilots, flight stabilizers and radar devices received their air baptism in these planes. Some of the advances already have been combat-proved in Korea.

General Electric's aviation program began in a small way in the twenties when aeronautical equipment was tested in a small plane rented for a dollar a minute. By 1930 the company had formed an aviation division and purchased a high-wing monoplane for general use.

In addition to the fleet of military aircraft on loan from the Air Force for research work, G-E also has a Navion which serves as a test plane for radio, navigational and other airborne equipment.

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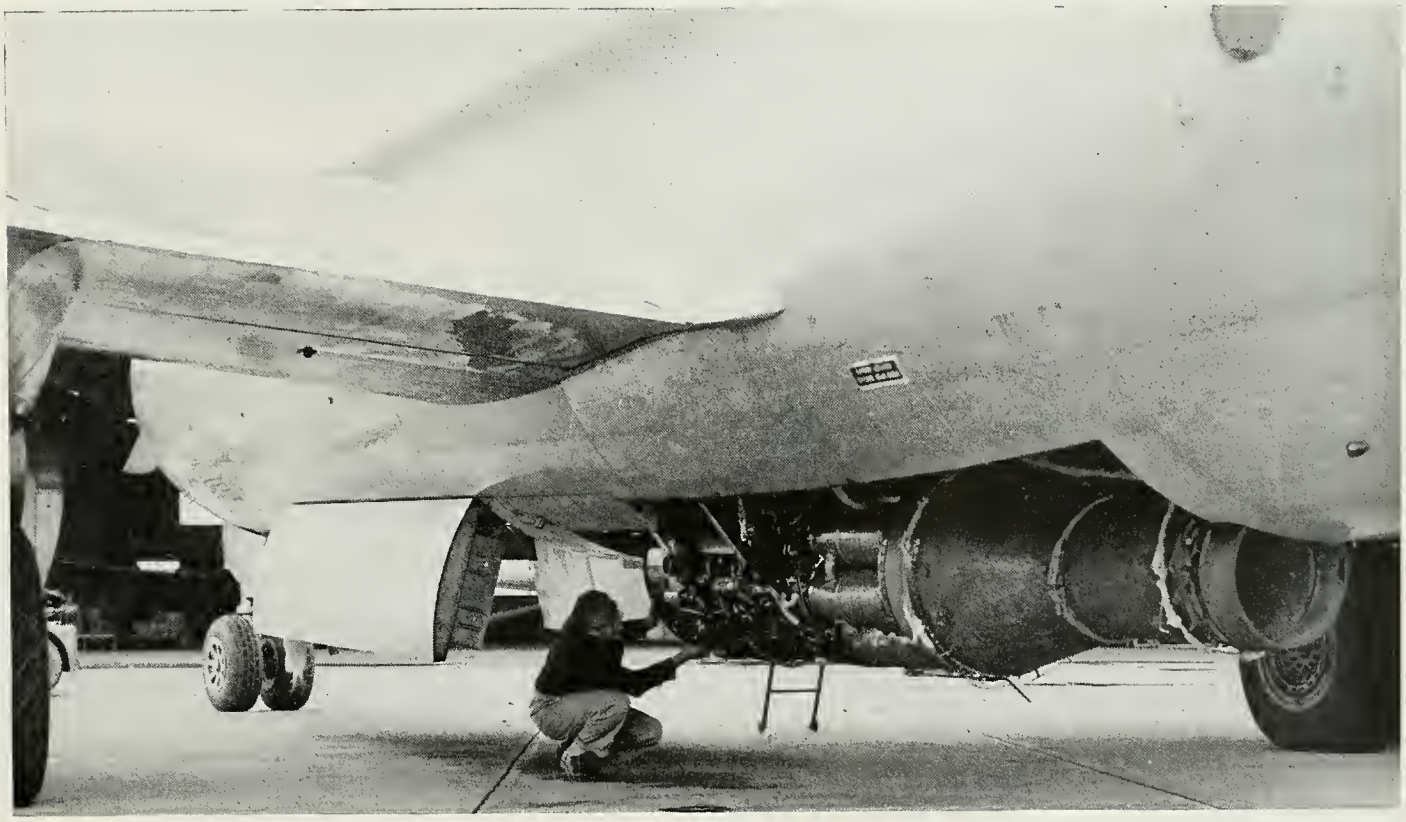
New engines and components are tested while slung from bomb bay of B-29. Here J-47-23 jet engine is made ready in Flying Test Bed.



Gleaming aft fuselage sections for Stratofreighters move down the Ryan assembly line.

Versatile Stratof

by Richard H. McElroy, C-97 Project Enginee

AS VERSATILE an airplane as there is in the U. S. Air Force today is Boeing's 300 to 350-mile-an-hour C-97 Stratofreighter.

The multi-purpose 74-ton transports not only are speeding heavy cargoes world-wide for the Strategic Air Command and the Military Air Transport Service, but they serve also as hospital airplanes, and can carry as many as 130 fully-equipped troops on combat mission.

And within a very few hours after any of these flights the newest model Stratofreighter, the KC-97E, can be quickly converted into the nation's fastest and most efficient aerial refueling tanker.

How can a single airplane—especially one designed originally as long ago as 1942—be versatile enough and have the high performance to take on all of these jobs in this day of highly specialized airplanes? The answer is elasticity of design—the same quality which enabled Boeing's B-17 Flying Fortress, conceived in 1932, to be the most formidable bomber in the air over Europe 13 years later.

The history of the Stratofreighter begins where the Flying Fortress ended. Its story is largely parallel to the design and production of the B-29 and B-50 Superfortresses.

In June 1942, three months before the first B-29 was test flown, Boeing proposed to the Army Air Forces a freight-carrying airplane able to match the B-29 in speed, range and ruggedness. The airplane would utilize, wherever possible, the identical parts used in the

Looking deceptively like tank turrets, these Ryan-built structures are refueling pods for Stratofreighters. Inverted and installed in rear loading bay, they convert airplanes from freight-carriers to aerial tankers. Fuel transfer boom is controlled from the pod.

B-29's. This would include wings, empennage, engines, landing gear and as many minor accessories as possible. In January, 1943, the first C-97 contract was approved for three experimental airplanes.

(Continued on page 19)

Scale model of Stratofreighter is checked in wind tunnel by Boeing engineer. With same wing design and power plant as the famous B-29, the C-97 was given a larger inverted "8" fuselage. It contains 6,140 cubic feet of usable space to stow cargo.

reighter

Boeing Airplane Company

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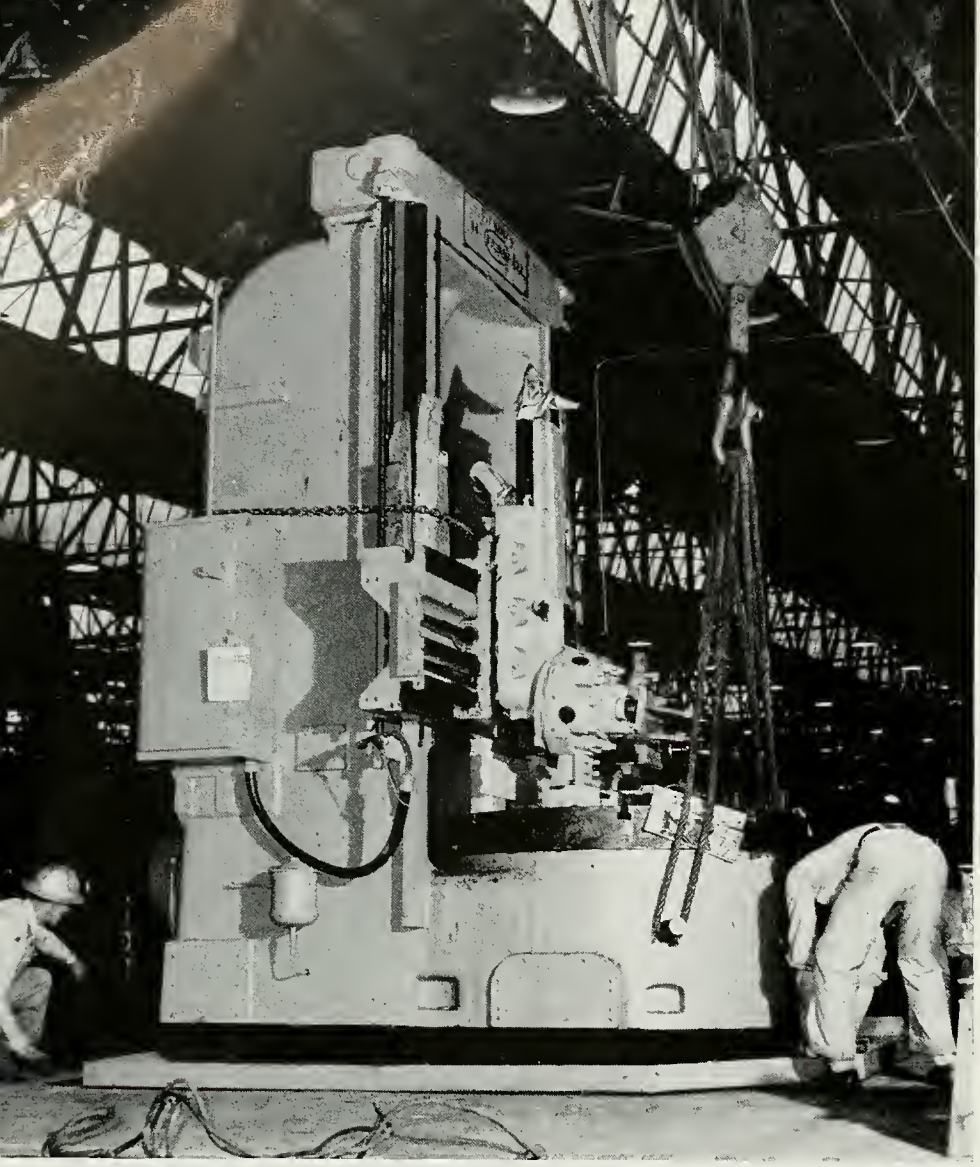
Showing refueling pod in place, this Boeing KC-97A Stratofreighter serves as aerial tanker. Fuel flows through telescopable boom which is "flown" to the airplane beneath by V-shaped controls.



Typicol "treasure" of modern industry is this new hard-to-get Bullord turret lathe. Tallest to come to the West Coast, the big Cutmaster will machine jet parts for Ryan.

Metal-shaping tools were never so urgently needed as now

Key to Production -- MACHINE

MACHINES that can make other machines—called machine tools—are the keystone of America's defense production program which is being rushed forward to stem the threat of Communist aggression.

Little known or discussed by the general public, the machine tool industry, though small itself, is the base of both our high standard of living and our power for defense. Today, vital aircraft production goals are not being met because of the scarcity of high priority parts badly needed by aircraft and engine manufacturers.

The deficiency stems from a problem which is fundamental to the rapid expansion of a complex industry. To a large extent, aircraft production is behind schedule because the new and improved engines of modern warplanes cannot be turned out in the required quantities. The engine manufacturers, in turn, are behind schedule because they don't have enough machine tools to transform vastly expanded production requirements into actual parts. Material shortages, particularly in aluminum, copper and steel, are causing dislocations but the most serious bottle-neck is the shortage of machine tools.

Temporary tool "transfusion" for industrial "bloodstream" came from thousands of tools U.S. stored after V-J Day. Bomber plant in Georgia was used for this purpose.

Jet engine manufacturers, alone, could use the entire output of the nation's machine tool production capacity. The current rate of tool production is about $700,000,000 a year, but by the end of this year machine tool orders totalling $3,000,000,000 will have been placed for defense production purposes.

At Ryan, the supply of machines and machine tools is being increased as rapidly as possible. Formerly, much of the

work on aircraft engine components required sheet metal forming and welding. Now, new jet engines require components which are mostly a combination of sheet metal parts and *precision-machined* members. This means a tremendous increase in the need for machine tools—tools which are larger and more accurate than ever before. Since Korea, a long parade of $2,500,000 worth of modern machine tools has been ordered for production use at Ryan. Less than a million dollars of this new equipment has been installed. The balance is arriving as fast as the new machines become available.

Typical examples of these new machine tools are some of the largest lathes, multi-purpose cutting machines and forming tools of their type. The massive Giddings and Lewis Boring, Drilling and Milling machine is a 19,000 pound tool which combines three important metal cutting tasks in one unit. Costing $31,500, this flexible machine can handle large, unwieldy structures with high precision. It is currently used at Ryan to build big jet engine parts and tools for jet engine production.

Ryan has a bank of six big Bullard vertical turret lathes, installed and on order, including the largest boring mill with raised bed ever installed on the Pacific Coast. With a fast-whirling table, which operates at speeds up to 160 RPM, this 32-ton giant stands 13 feet high. Jet engine exhaust cones, huge external wing

TOOLS

tank sections and other large structures are machined on this useful new addition to the Ryan plant.

On critically short machines, such as the vertical turret lathes and radial drill presses, work is scheduled on three daily shifts, six days a week to make maximum use of the machine facility. Only on Sundays are the machines shut down for necessary maintenance work.

The urgent industrial problems created by machine tool shortages cannot be easily relieved. The recently appointed Aircraft Production Board, under the capable direction of Harold R. "Bill" Boyer, former Director of Production Engineer-

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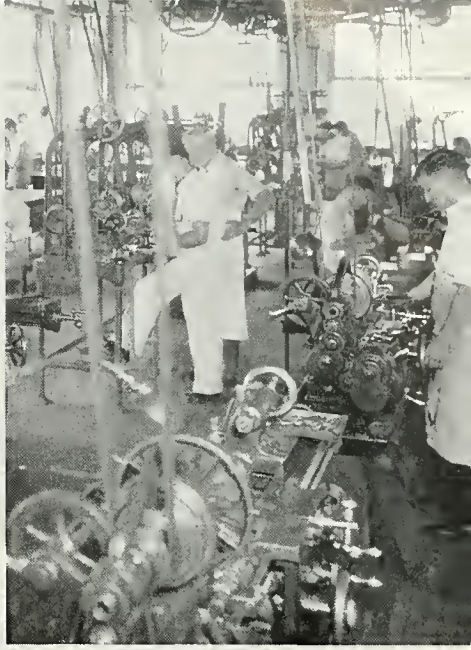
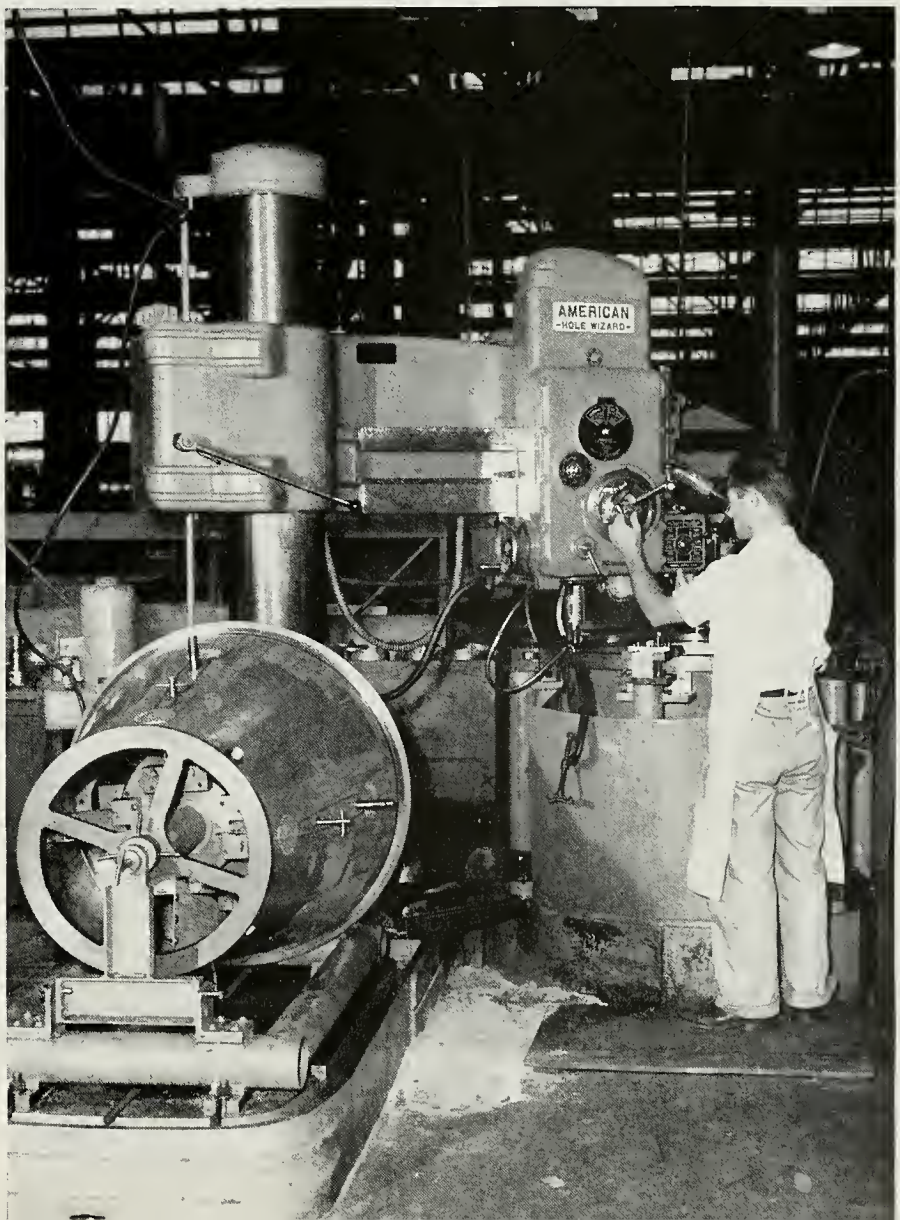
H. R. Boyer, Aircraft Production Board head, and Navion owner, has vigorously attacked the machine tool bottleneck.



View of belt-driven machine shop of another era dramatizes the swift progress made in tool development.

Large radial drills are used to machine jet engine exhaust cones at Ryan. Great accuracies of jet parts have accentuated the demands for big precision machines.



Skis are fitted on a Navion for special cold-weather tests being conducted this winter by the Air Force from a base in Canada.

Operation "SOIAS"

SLIDING ON ICE AND SNOW

SPECIAL cold-weather operations with three Ryan Navion Super 260's will be conducted by the Air Force this winter from a Canadian base to obtain ski design criteria and determine the most effective use of airplane skis in a wide range of snow and ice conditions.

Modification of the planes, including installation of heaters and instruments to record ski data, has been effected in the engineering shops of Wright Air Development Center of Wright-Patterson Air Force Base, Dayton, Ohio. Test will center on the utilization of the wheel replacement ski.

For project "SOIAS"—Sliding On Ice And Snow—the winterized Super 260's will operate in a 300-mile radius centering at Kenora, Ontario, in the Lake of the Woods Country just above the Canadian border almost due north of Minneapolis. A Northrop YC-125 and a Douglas C-47 will be used in support of the project.

Flights begin this winter and will continue through April, 1952. They will in effect be an extension of a similar project conducted during the winter of 1950-51, when ski installations were tested on Navion L-17B aircraft at Yellowknife, Northwest Territory, Canada.

The Navion Super 260 commercial plane is a later model than the L-17B military liaison type. Flight Test Division crews that were on the previous project have been reassigned to the Navion "SOIAS" operation.

The 1950-51 tests showed that the Navion was well adapted to ski operation because the nose ski can be readily lifted out of the snow to give the positive angle of attack necessary to accomplish takeoff.

With its normal wheel landing gear, the Navion has demonstrated ability to operate under severe conditions of snow, mud and slush during winter months. A typical Navion winter operation has been the transport of parts and supplies to the snow-covered 6500-foot altitude mountain field of the Yellow Pine Mine at Stibnite, in the primitive area of Idaho.

Another privately owned Navion, during the severe blizzards of 1948-49, at Alliance, Nebraska, assisted Air Force "airlifts" under conditions where snow depths were from two to 20 feet, wind velocities were often above 60 miles an hour, and visibility was near-zero, requiring the pilot, Edward Kooper, to find his way back to the airport by following ranch fence lines.

MACHINE TOOLS

(Continued from page 13)

ing for General Motors, has been concentrating its efforts on the machine tools problem. Boyer and his staff have made effective progress. After surveying the broad picture of aircraft schedules, Boyer commented: "If I don't do another job here, I'll be satisfied if I get the machine tool industry expanded."

Just what is the machine tool industry and what part do machine tools play in this day of precision manufacture? Machine tools are nothing more or less than the "carpenter's tools" of the metal working industry. They cut, drill, grind, shave and otherwise shape metal just as the carpenter's saw, brace, bit, sander and plane are used to "work" wood.

ALTHOUGH there are 250 firms producing machine tools, the industry is relatively small. When called upon for staggering increases in production, as at present, its problems are obvious. It deserves, and finally is receiving, special treatment.

Even with these measures, the deliveries of machine tools to the aircraft industry will not be sufficiently increased for at least another ten months or a year.

In no way is the machine tool situation hopeless, nor has there been a lack of study and planning for expanded military production requirements. Much of the problem arises from the need to work with a number of new and much tougher materials, and to turn out a wide range of pieces of large diameter and thin wall section. This has been particularly true in the case of jet engine production.

In anticipation of just this situation, The joint Army-Navy Machine Tool Program (JANMAT) was set up immediately following World War II. When government contracts were terminated, machine tools were bought by the government through an Act of Congress and two huge machine storage depots set up in the former Bell bomber plant at Marietta, Georgia, and the former Martin bomber plant at Omaha, Nebraska.

Of the 1,700,000 machine tools which have already been diverted to aircraft and other defense production, some 35,000 pieces were those stored after V-J Day for future aircraft use. Unfortunately, many of these tools are unsatisfactory or obsolescent, most of them not being precise enough to handle today's complex engines, airplanes and component parts.

Even so, the Air Force's theory of storing machine tools paid off handsomely in getting the expanded military aircraft engine production program rolling. Manufacturers who would otherwise have had to wait for delivery of new machine tools were able to select needed grinders, milling machines, lathes, drills, routers, press brakes and screw machines from the stock for which the Air Materiel Command was housekeeper.

As soon as the prime contractors had the necessary production facilities, the tools were shipped but ownership retained by the government. Upon completion of contracts (which may not be until the end of the present emergency), it is planned that the tools be returned to the Air Force pool.

In addition to the bottleneck-breaking program of the Aircraft Production Board, other significant means are being taken to speed the program. Curtiss-Wright, for example, has been buying machine tools in Italy, Switzerland, Germany and elsewhere in Europe, acting as buying agency not only for themselves but for the Air Force, for use by all military contractors. The total contribution from Europe is small but extremely important because it permits production to get under way right now in advance of receiving the balance of the needed machine tools from American manufacturers. Fortunately, there is little conversion problem in adapting the European tools.

And, in Los Angeles, the U. S. Industrial Tool Company has come up with a novel machine tool rental plan, making available their large inventory of tools on a flexible rental plan by the day, week or month. Thus, some sub-contractors for the aircraft industry with small shops can avoid tieing up cash in tooling that will stand idle when the job is completed. It gives shops of all sizes the run on a $10,000,000 tool crib.

At a recent Pentagon meeting, other suggestions for alleviating the machine tool bottleneck included substitution of single-purpose tools for multi-purpose equipment; modernizing some of the mothballed Air Force tools still in the

(Continued on page 21)

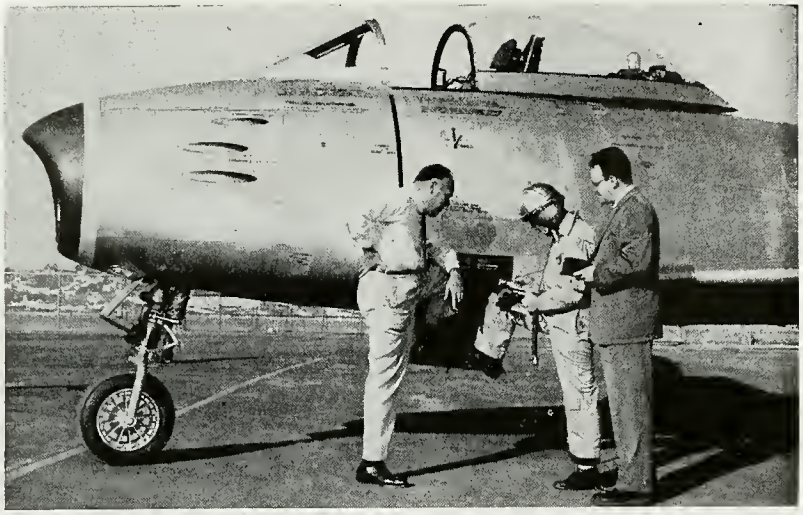
Like this crude cabin, everything that contributes to Man's Material Welfare (standard of living) is the product of the Natural Resources at his disposal, plus the Human Energy he applies to changing their form, multiplied by the efficiency of the Tools available.

The only variable in this equation is Tools. The world has just so much Natural Resources; so much Human Energy. It follows that the economic system which brings into use the greatest number of efficient Tools benefits the greatest number of people.

The more American workers produce efficiently with Tools, the more there is for them to divide. The more you add to the world's goods, the more there is for you to share.

When the power saw replaced the axe, the workman no longer needed to spend full time cutting trees. He could make other things. Tools made it possible.

Now fewer men need fewer hours to make more products for everyone. Work is now the time a man spends at a machine. That is the story of Tools.



NEW PROJECT—Ryan's use of Air Force F-86 Sabrejet for a special electronic research project will be supervised by, left to right, W. S. Cockrell, head of the development laboratory; James Hanson, flight test engineer; and Owen S. Olds, head of the electronics section.

Electronic Research Project Under Way

Advanced electronics equipment is being installed by Ryan engineers in this Air Force F-86 Sabrejet for a special research project involving flight operations of a confidential nature. Before the test phase of the electronics devices was started, James Hanson, Ryan flight test engineer, had to be checked out in this "hottest" plane on active service in the Air Force. Although he had never before been at the controls of a jet plane, Hanson performed like a veteran on his very first flight after being "briefed" on the ground by Capt. John C. Newman, test pilot for the Air Materiel Command. Newman flew the F-86 to San Diego from Wright-Patterson Air Force Base, Dayton, O.

NAVIONS IN THE DESERT

(Continued from page 5)

eastern fields to tankers at the terminal in the Mediterranean.

On June 29, 1949, Navion N-8944H, "The Bee," was ferried from Dhahran to Beirut, to be stationed at Beirut for the Trans-Arabian Pipe Line Company which requested the airplane so that there would be an aircraft available twenty-four hours a day. This was necessary to help speed the construction of the largest pipeline in the world. This airplane would be used to transport personnel, for the shipment of priority cargo, and for emergencies. At first glance conditions of flight seemed to add up to a routine "milk run" kind of job. But it was not uncommon for pilots to leave Beirut with the Lebanese coast buffeted by cold fronts and find a destination such as Turaif, Saudi Arabia or Angle Point, Trans-Jordan, cloaked in dust with one-half mile visibility.

It may well be asked, then, how Navion flight assignments were so successfully accomplished during the worst winter months in an area where mountains reach as high as 10,000 feet? The answer is simple. Aramco's Aviation Department takes no unnecessary chances.

ALL Navion flights were made entirely with reference to the ground and it is Aramco policy never to fly single engine airplanes on instruments or on top unless absolutely necessary; this, despite the fact that Navions are equipped with a full instrument panel, radio compass, and V.H.F. radio. Add to this a constant and careful study of weather conditions and terrain in that area; or many times by simply sweating it out on the ground.

A good indication of the care used by Aramco pilots was the many trips from Beirut to Damascus, Syria, a 30-minute flight ordinarily. There were three routes across the mountains. Directly over the mountains, some of which reach to 10,000 feet; around them to the south, or to the north. Sometimes, in an effort to find the best weather route, all three routes were tried, making the journey to Damascus stretch to an hour and fifteen minute flight.

On one return flight a Navion pilot reached 15,000 feet with full load over Damascus. Despite snow and rain squalls all through the Bakaa Valley, the area through which he would have to fly, broken clouds over the Mediterranean which were visible from fifty miles, permitted a flight to Beirut. No break in the clouds would have meant no flight.

Maintenance, which most airmen will agree gives a pilot ninety-nine per cent of his confidence, is provided all-out by Aramco. The engine in 44H (the Navion in Beirut), for instance, accumulated 481.20 hours over a period of nine months. It did not fail, but was changed according to Aramco practice. During the first six months of operation in Beirut, this craft was one hundred per cent available. All told, only ten minor parts were replaced to assure availablity—a fine record, anyone will agree.

It is true that many changes have been made to acclimate the Navion airplane to its work load in Saudi Arabia. However, the fact that it has been sturdy enough to weather the difficulties until they could be ironed out—is proof of a fine piece of machinery.

TURBOSUPERCHARGERS FOR AIRLINERS

(Continued from page 1)

sary to prevent "detonation" or backfiring which would reduce the power rating of the engine.

From the intercooler, the compressed, cooled air goes to the carburetor and is mixed with fuel. The fuel-air mixture passes to the inlet of a gear-driven internal supercharger, which compresses it further and distributes it to the intake manifold of the engine.

The degree of compression of atmospheric air drawn into the turbosupercharger is determined by the speed of the rotor, which is controlled by the amount of hot gas allowed to pass through the turbine wheel. This gas flow is regulated by a wastegate in the exhaust system. With the wastegate closed, all exhaust gas will be forced through the turbine, and the bucket wheel will revolve at high speed. With the wastegate wide open, most of the gas will escape to the atmosphere without driving the turbine wheel. Rotor speed can be varied by controlling the wastegate so that the correct amount of supercharging at any altitude can be delivered to the engine. An automatic device regulates the wastegate position so that the carburetor pressure remains constant for a given boost setting at all altitudes.

(Continued on page 17)

TURBOSUPERCHARGERS FOR AIRLINERS

(Continued from page 16)

One of the main requirements of a good turbo installation is flexibility in the connections between the engine and the turbo. This need arises from the large temperature rise of the exhaust system parts during operation and the big difference in temperature between the compressor end of the turbo, which runs at −25° F., and the turbine, only 12 inches away, which is subjected to temperatures as high as 1730° F.

The greatest amount of thermal expansion takes place in the exhaust system. In order to allow the various parts to expand when heated, slip joints are provided. Ball-type joints are also installed to provide for the misalignment of various parts of the exhaust system. (These joints, as well as the entire exhaust system for the Stratocruiser aircraft, are manufactured by the Ryan Aeronautical Company of San Diego. The systems are fabricated from 19-9DL stainless steel. Ryan also fabricates the important wastegate valves which divert the exhaust gases to the turbo assembly. These precision made valves are formed from Inconel X—an extremely high strength alloy created for elevated temperatures. —Ed.)

The advantages of turbosupercharging are many. By increasing the air pressure in the engine cylinders, the turbo greatly increases the engine horsepower and provides full rated sea level power to altitudes as high as 30,000 feet. Fuel consumption is reduced by the increased cylinder pressure and the utilization of exhaust gas energy. By these two advantages—increased horsepower and reduced fuel consumption—the turbo enables the aircraft to fly at higher altitudes and thus increase its range and payloads.

AS greater power and higher altitudes become available, more speed is realized. For each 1,000 feet of higher altitude, airplane speed is improved approximately 1% due to reduced drag and elimination of low-altitude turbulence. Therefore, an altitude increase of 15,000 feet would improve airspeed 15% plus the still larger speed increase due to the higher engine power provided by the turbo.

Additional advantages from turbo installations are the avoidance of low-altitude storms, better frequency of schedules and increased passenger comforts which come from the higher altitudes which turbos provide.

Strange as it may seem, the conditions under which the BH4 turbos operate in the Boeing Stratocruiser have proved to be actually more severe than are normally experienced with military airplanes. The rotor speed is slower in the commercial application but the temperature of the engine exhaust gas flow into the turbo is much higher.

In airline operation, economy is heavily emphasized and with cruising fuel mixtures normally used, the temperatures become very high. The temperatures of the exhaust gases entering the turbo nozzlebox often range between 1700 and 1730°F. throughout much of the cruising operation. Military airplanes, on the other hand, normally operate with higher engine powers and richer fuel mixtures and have temperatures approximately 150 degrees lower than their commercial counterparts. The reduced temperature is apparently due to the cooling effect of the small amounts of unburned fuel in the richer, higher-power fuel mixture.

The BH4 turbosupercharger was especially designed for medium altitude cruising. The Stratocruiser operates a great proportion of the time at medium altitudes, or up to 25,000 feet, at engine cruising powers. The BH4 weighs only 220 pounds and, up to 25,000 feet, delivers an air flow of 224 pounds per minute with a discharge pressure of 27.8 inches of mercury absolute.

(Continued on page 21)

ADMIRE EQUIPMENT—Brig. Gen. Enrico Cigerza and Lt. Col. Franco E. Fiorio of the Italian Air Force, who praised Ryan production methods, are shown at Bullard turret lathe with Ryan representatives. Left to right, C. L. Foushee, Jr., service manager; W. G. Hubbell, chief metallurgist, Cigerza, Fiorio and William Brotherton, public relations.

Italian Airmen Visit Ryan

Top Italian officers, including the Senior Italian Military Attache from the Italian Embassy in Washington, visited Ryan recently to observe Ryan production methods and consult about ceramic coatings. Brig. General Enrico Cigerza, Air Attache of the Embassy, and Lt. Colonel Franco Fiorio, Technical Officer of the Embassy, came to San Diego principally because of the wide-spread recognition which Ryan ceramic coating leadership is attaining.

"We came to Ryan," General Cigerza said, "to learn about your ceramic work because the concensus of technical literature available in Washington shows that you are doing the most successful work in this field. These applications are extremely important to Italy because we are critically short of almost all of the materials which go into stainless steels."

In addition to ceramics, the airmen were especially interested in modern techniques in welding, forming and machining of stainless alloys. After a conducted inspection tour of the factory, Colonel Fiorio stated that "we are amazed at the things which you do with welding. Your progress in welding and your facilities are the most advanced that we have seen in visiting a large number of plants."

The officers explained that their objective in gathering knowledge on newest manufacturing methods is prompted by the large number of unemployed—two million people—in Italy. With only 5,000 now employed in Italian aircraft industry, they are endeavoring to put more skilled, unemployed workers into productive activities. Their visit was sanctioned by the U.S. Air Force.

INTEGRAL COLLECTOR

(Continued from page 6)

ates seven joint assemblies and a substantial amount of welding. The time may never come when complex exhaust systems will be fabricated by pressing a single control on a mammoth machine but this new design is a step in that direction.

Conceived by Pratt and Whitney engineers, the -59 exhaust encompasses a number of interesting innovations. It is a "floating" exhaust system without actual attachments to the cylinder heads of the engine. Each exhaust port ejects its blast through an ingenious spring-loaded capsule joint which "floats" between the cylinder heads and the exhaust equipment. This gives the entire manifold a free, universal action at the cylinder heads and permits the suspension of the equipment by a few simple link attachments to the engine.

Looking deceptively like a conventionally-designed exhaust system, the -59 consists of seven headers, which serve four cylinders each, and a collector ring that channels the hot gases to a tail-pipe. Closer scrutiny discloses that this entire structure is joined together with only seven tongue-and-groove joints and there are no flexible joints actually incorporated in the manifold. Another unique feature of the design is the inclusion of finned seat supports which are welded to the 28 exhaust port legs.

While the unique new design has simplified the -59 structure, by the elimination of individual components, it has imposed a number of perplexing production problems. To meet these challenges, Ryan production and laboratory experts have introduced new forming and processing techniques. With them, the -59 is being successfully fabricated in substantial quantities and exhaust system manufacturing standards are being pushed to new highs.

Due to the integral design, the -59 stampings are the largest exhaust manifolds parts ever produced at Ryan. They must be formed on machines with a bed size of 48" x 60" or greater. The forming of the deep-contoured surfaces is made doubly difficult by the highest quality and tolerance requirements ever demanded of Ryan sheet metal and machined-member fabrication. To accomplish this task, Ryan has developed an unusual forming technique in which the metal flows into smooth, sweeping curves without wrinkles or folds. Maximum gauge thickness is held in the most critical contours and a fine-grain metal structure is maintained to improve the ductility and toughness of the manifold.

Both the -59 exhaust systems and those for the -53 engine, which Ryan also builds, are made from type 310 stainless steel and their manufacture marks the first occasion when Ryan has employed this particular steel formula in production. 310 has a number of characteristics which require special handling in production. For instance, with its 25-20 chromium-nickel proportion, it is extremely susceptible to copper embrittlement.

After forming, the stampings are carefully fitted together with electric spot welding to hold them in perfect alignment prior to seam welding. Then, the parts must be pickled in an acid solution to remove all traces of copper picked up from the electrodes. Otherwise, under the application of heat, the particles of copper would form a brittle-phase alloy with the steel which would render the manifold useless in service.

Between forming operations, the 310 stainless steel is furnace-annealed to remove the effects of work-hardening and, again, a problem arises. The standard nitric-hydrofluoric acid baths will not remove oxide scale formed on the parts surfaces as a result of the furnace heating.

The solution to this dilemma was provided by Bernard Floersch, Chief Chemist, by means of a pre-dip procedure.

SEAM welding of the -59 sections is accomplished by heliarc welding technique in which a blanket of inert gas envelopes the weld metal and protects it against oxidation. Pratt and Whitney welding requirements are high, demanding that the seam line edges fit together perfectly and that the flanges must be squarely formed with snugly-fitting interior surfaces. The welds themselves must be narrow and uniform in width. One of the most important factors, which ing these high standards, is the excellence of the forming technique. The free flowing of the metal into sharp-radii curves and upstanding weld seams is an outstanding benefit derived from this newly devised method.

The R-4360-59 and -53 designs are the first aircraft engines of very large horsepower in which the exhaust system has been included in the engine's bill of material. Heretofore, the exhaust equipment has been specified or designed by the airframe manufacturer. The Pratt and Whitney exhaust systems mark a change from this tradition and place these components in the realm of original engine equipment. In view of the exceptionally high manufacturing precision which Pratt and Whitney have always maintained in their engines, it is not surprising to find this same philosophy guiding their design dictates in the field of sheet metal and machined exhaust manifolds.

For instance, all machined surfaces of the large -59 exhaust assembly, including the tongue-and-groove flanges and capsule joint seats, are required to be machined to less than a 50 microinch surface finish. The capsule joint seats must be accurately machined to within .001" outside diameter and .002" inside diameter.

These seat assemblies are fabricated from three different concentric metal parts and seam welded to each port leg of the system. The seat itself is made of very hard Ni-resist metal which is shrunk-fit into a stainless steel ring. This assembly is again shrunk-fit into a finned aluminum ring component which aids in cooling the structure. The three concentric parts are then drilled and pinned together with stainless steel pins to prevent their separation under high temperature conditions.

BETWEEN these seats and each cylinder head of the R-4360-59 engine, an ingenious capsule joint, designed by Pratt and Whitney, is installed to provide a flexible channel for the escaping exhaust gases. Consisting of two tubes, one telescoped within the other, these joint assemblies have a strong helical spring which extends the tubes to their maximum length. When the joints are partially collapsed and placed between the exhaust system and the engine cylinder heads, the springs hold the ends of the tubes tightly against the seats of the two structures.

Besides the -59 exhaust collectors, Ryan is also building another Pratt and Whitney-designed exhaust system. This is the -53 manifold which is similar to the -59 design except that the header and collector components are completely separate. These exhaust systems are being shipped to the Ford Motor Company Aircraft Engine Division at Chicago where the Pratt and Whitney R-4360-53 engines are being manufactured under a licensing agreement. The -53 power plants are installed in Convair B-36 Intercontinental bombers.

Ryan is also delivering ceramic coated -59 and -53 exhaust systems to Pratt and Whitney for extensive service testing. These orders are a result of the outstanding success of the Ryan ceramic coated exhaust systems under the comprehensive flight tests which the Development Laboratories conducted.

In the race to power the world's best air force, Pratt and Whitney is playing a leading part. Ryan is playing an important role, too, in providing the high temperature metal requirements for both the conventional engines and jet power plants which this pioneering company is creating.

300,000 FEET UNDER THE SUN

(Continued from page 3)

Diego 25 years ago set off a wave of aviation enthusiasm that resulted in the creation of Lindbergh Field with land dredged from the bay bottom.

Today the Ryan plant appropriately is located on Lindbergh Field, which over a quarter of a century has been developed into one of the nation's major municipal airports.

Don't get the idea it never rains on the Ryan portion of Lindbergh Field. There has been not only rain, but sleet, hail and on extremely embarrassing (though rare) occasions, even snow. But inclement weather is so much the exception that on almost any day of the year —in winter as well as summer—Ryan's 300,000 feet under the sun is alive with the varied activity of a huge aircraft plant.

ANSWERS IN THE SKY

(Continued from page 9)

DIRECTING the Flight Test Center is C. G. Talbot, a 37-year-old engineer who last year was given the company's highest honor for employee achievement, the Coffin Award, for "his initiative, energy, technical ability and sound judgment in the flight testing of aircraft." He has highly specialized crews under his direction which take care of the ground procedures as well as the flying duties.

Key man in flight operations is one of the most versatile pilots in the country, E. M. Beattie, an American Airlines engineering pilot. Beattie and his fellow crewmen, Co-Pilot Harry Etzel and Flight Engineer Newell Davis, are flying under contract with General Electric.

Beattie alternates with equal ease between jet and piston planes. It is not unusual for him to land the B-45 and immediately take off for a four-hour high altitude flight in the B-29. To test other types of equipment, he flies a Douglas B-26 "Invader" and a Boeing B-17 "Flying Fortress." All the planes are on loan from the Air Force for the specialized test program.

It is all in the day's work for the flight crew to leave the ground in summer temperatures of 95 degrees and less than an hour later find themselves in temperatures of 65 degrees below zero in the stratosphere.

Or, if it's a jet flight, they are likely to have filled up two hours before lunch by flying to Washington to Dayton and back to Schenectady.

RYAN PT-22 "COMMUTER"

"Commuter" may well turn out to be an appropriate post-war name for the Ryan PT-22 military trainer if recent news stories from the Boeing and Douglas aircraft plants are any indication.

Originally called the Ryan "Recruit" by the Air Force in keeping with its use for initial instruction of aviation cadets, the PT-22 is finding a new role as a vehicle ideally suited to vault over the heavy city traffic which precedes and follows shift changes at aircraft factories.

Last month the Reporter carried a feature about an employee at the Boeing plant in Seattle who commuted by PT-22. Now comes Douglas with a similar story in a recent issue of Douglas Airview News:

When Lou Ragley, Douglas crew chief, finishes a day's work he climbs into his PT-22 parked on the flight line and is off.

About the same time the last of his colleagues are working their way out of the parking lot, Ragley is 3000 feet above Sepulveda Blvd. winging his way home to Canoga Park at about 120 mph.

From Santa Monica (Douglas plant location) to San Fernando Valley Airport takes about seven minutes. In a car, it would be a 40 to 50 minutes battle against the 5 o'clock traffic. He figures his PT-22 costs about the same to operate as a Cadillac over the same route, but much swifter. Of course, doing his own maintenance work helps out some.

When Ragley calls the tower at Van Nuys, his wife starts for the field. The four-mile drive to his home winds up the day.

VERSATILE STRATOFREIGHTER

(Continued from page 11)

The key to the success of the B-29, the "117 airfoil," also was the trump card of the XC-97. Designed by Boeing aerodynamicists, the wing possessed lower drag characteristics per pound of life than any other airfoil and at the same time had greater strength, greater volume for gasoline storage, better stall warning, and it was fitted with the biggest and most efficient flaps yet devised.

With utilization of the Superfortress wing for the C-97, the same four engines was a natural choice—four Wright Cyclones of 2200 horsepower each.

Adaption of the B-29 fuselage for cargo was another matter entirely since its configuration was not at all practical for the XC-97.

The problem was solved by giving the new airplane an inverted figure "8" fuselage configuration with the lower lobe the same diameter as the fuselage of the B-29. The wing and landing gear continuity of the Superfortress thus were maintained through the lower fuselage lobe of the XC-97 with no change.

The large upper deck section was streamlined into the lower lobe and contained the bulk of the cargo volume. The interior of the new double-decked transport was designed to combine the maximum of space utilization with cargo handling ease. Huge rear "clam shell" loading doors were designed to enable objects as long as 61 feet to be loaded into this area quickly and simply. Cargo could be hoisted through these doors from the ground or from trucks by means of a self-contained and electric-powered single-rail crane. Vehicles—trucks, light tanks, ambulances and artillery—could be loaded under their own power. In all, 6,140 cubic feet of usable cargo space was made available—more than twice the volume of any transport airplane then flying.

(Continued on page 20)

The Boeing XC-97 made its first flight Nov. 9, 1944, and was the proto-type for all subsequent military Stratofreighters and commercial Stratocruisers. Although many refinements have been made in these models, the basic configuration, the wing-span and body length have remained the same.

Upon the completion of the first three experimental airplanes an Air Force contract was issued Boeing for 10 service test Stratofreighters to be designated XC-97's. And by this time commercial airlines, impressed with the record of the XC-97's, had expressed interest in a commercial version of the airplane.

With every effort bent on sales, contracts were obtained with six airlines for a total of 55 Stratocruisers and at the same time a major set of revisions were planned for future Stratofreighters.

The last four YC's became as nearly twins of Boeing's newly-developed B-50 Superfortress as earlier Stratofreighters were to the B-29's.

The B-50 was not merely an improved B-29; it was 75 per cent a new airplane. The YC-97A's as three of the four new airplanes were to be designated, matched the B-50 advances system by system and only their outside dimensions and loading facilities remained the same.

Engines of the two airplanes also were new. A power boost of 59 per cent was given by installation of 3,500 horsepower Pratt and Whitney Wasp Major engines equipped with Ryan exhaust collector systems incorporation provision for exhaust-driven turbosupercharger. The height of the vertical tail on each airplane was increased by five feet to accommodate the extra power, and gross weight was increased 10,000 pounds.

The six "YC's" and three "YCA's" cut their service test teeth with the Strategic Air Command, with the Air Proving Command, with MATS and with Air Materiel Command headquarters assignments. The tenth airplane—designated a YC-97B—was redesigned as a personnel transport, officially named a Stratocruiser, and immediately joined MATS.

It was in May 1949 that one of the S. A. C. Stratofreighters was able to demonstrate its freight-carrying capacity to the world. In 27 airlift flights into beleaguered Berlin the airplane carried a record Air Lift load of over 2,000,000 pounds of cargo.

Thirteen days after the first of the "YC" Stratofreighter was flown, the first of several production contracts was issued to Boeing for C-97A and C-97C airplanes. Because of the expanded manufacturing program, Boeing decided to subcontract many of the major assemblies to qualified manufacturers. Ryan Aeronautical Company was selected as the source for the huge aft fuselages—consisting of sections "45, 46 and 47", including the cargo doors—and all floor beams for the entire airplane. Deliveries from Ryan began early in 1949 and are increasing.

The new Stratofreighters, which are in Pacific Airlift service today, have a gross weight of 150,000 pounds, an increase of 12,000 pounds over the YC-97A.

How well they have been accomplishing their day-in, day-out assignments for the big military airline is indicated by a daily utilization figure of 11.22 hours for the month of October, 1951, by one of the MATS Pacific Division double-deckers.

C-97A's now often fly non-stop Tokyo to Hawaii and from Hawaii to San Antonio, Texas. On one Air Force test flight a standard C-97A took off at a gross weight of 174,500 pounds carrying a useful load of 96,500 pounds—18,500 pounds more than the empty weight of the airplane itself.

STILL another version of the Stratofreighter is the C-97D command transport first delivered to the Air Force Strategic Air Command in the fall of 1950. Each airplane in this series is fitted as a mobile advance headquarters and has complete living facilities for staff personnel.

The C-97D airplanes can be distinguished from other C-97's by two standard B-50-type streamlined 700-gallon fuel tanks mounted singly beneath each of the transport's outer wing panels.

Perhaps the most spectacular of all the jobs for which the Stratofreighter has been designed is its role as an aerial refueling tanker. Utilizing the Boeing-designed Flying Boom system, the Stratofreighter has proved an ideal airplane for this mission.

Brackets were installed on the Stratofreighters' cargo deck for rapid installation of large, but portable, fuel tanks. The airplanes' clam-shell cargo doors were removed and a packaged Flying Boom unit—complete with a station for a boom operator, boom controls and the boom itself—was designed to be attached beneath the airplane on the same brackets which normally held the doors.

The result is a convertible airplane capable of carrying hospital patients, troops, heavy cargo or fuel on alternate missions.

Because it was already building the aft fuselage section where the refueling equipment is located, Boeing asked Ryan also to build the "pods." Production was greatly expedited because Ryan already had the tooling for the cargo doors which are replaced by, and have the same hinge points, as the refueling pods.

Among the many airplanes refueled by Flying Boom have been the Boeing B-50 Superfortress and B-47 Stratojet bombers, the North American RB-45C Tornado reconnaissance jet bomber and F-86 Sabre fighter, and the Republic F-84E Thunderjet fighter. F-84G's now in production are all equipped as Flying Boom receivers.

Much has been printed about the tasks to which the Stratofreighter has been assigned in the present United Nations defense of Korea. Much has not been printed because it cannot yet be told for security reasons. Much more could be said of a specific nature concerning future growth possibilities for this series of airplane. But, likewise, it cannot be told for security reasons.

One thing, however, can be said for certainty: The Stratofreighter will have a long life, growing and expanding in performance, usefulness and in quantity with the passing years.

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Ryan combustion chambers for G-E jet engines receive last precision check. Like perforated "cannon barrels" they will fire explosive fuel-air blast.

ON THE COVER

TURBOSUPERCHARGERS FOR AIRLINERS

(Continued from page 17)

THE average life between overhauls in the BH4 turbo has increased steadily from 279 hours in October, 1949 to 527 hours in August, 1951. At the present time, the average overhaul life has improved to such an extent that two of the airlines are operating their turbos on the basis of an 800 hour overhaul period and are currently service testing 900 hour overhaul periods. A large factor in this progress has been maintenance of accurate records of turbo overhaul periods by the airlines which have enabled General Electric to improve those parts of the turbo that needed attention.

While the present powerplant in the Stratocruiser uses a turbo in conjunction with a geared or internal supercharger, the latest improvement is an arrangement which eliminates the geared supercharger and permits the turbo to supply all of the supercharging required by the engine. This results in three important advantages:

(1) The 500 horsepower required to drive the geared supercharger can now be applied in the new power plant to propelling the airplane.

(2) The temperature of the air to the engine cylinders is reduced approximately 200°F. since there is no further compression of the air after it has passed through the air cooler. This permits raising the cylinder pressure, or packing more air into the cylinders at the lower temperature, and raises the power output of each cylinder.

(3) The exhaust gas is now used to much better advantage. At present, the geared supercharger limits the airflow to the engines, at cruising conditions, due to the low engine speed. Since the air output of the turbo is thus limited, only a small portion of the available exhaust gas is used to turn the turbo and a large part of the exhaust energy is dumped through the wastepipe.

The new powerplant arrangement has been conservatively rated to provide 4,000 h.p. for take-off, or approximately 15% higher horsepower than the present powerplant and over 10% reduction in fuel consumption. Test stand operation has shown that even larger improvements in power and fuel consumption are possible. These will be translated into advantages in range, payload, speed and take-off distance. These new turbosupercharger developments, combined with the record of achievement already attained, indicate that turbos are making a major contribution in the progress of commercial aviation.

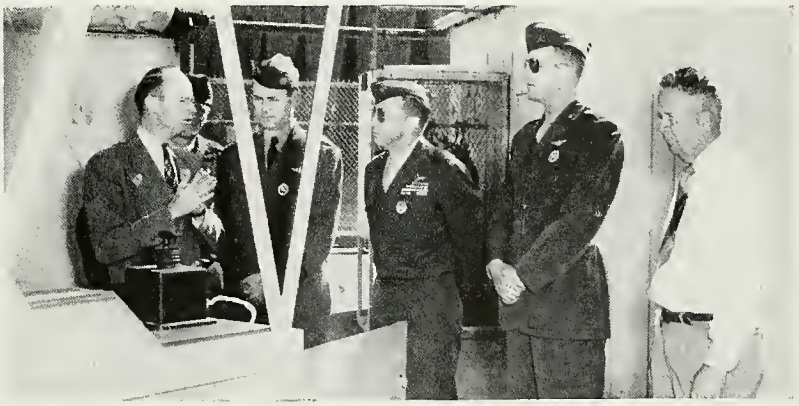
OBSERVE NEW DEVELOPMENT—Rear Adm. J. B. Moss, center, and other Navy officers, recently visited Ryan plant. Left to right, T. Claude Ryan, president; William T. Immenschuh, executive engineer; Moss; Comdr. Cedric W. Stirling, local Bureau of Aeronautics representative; Comdr. F. E. Rogozienski; and R. E. White, chief project engineer, metal products.

TOP OFFICERS VISIT PLANT

Top-ranking Navy and Marine Corps officers from Washington headquarters viewed confidential Ryan products in recent visits to the plant.

One group was headed by Rear Adm. J. B. Moss, Bureau of Aeronautics assistant chief for materials and services, who was accompanied by Comdr. F. E. Rogozienski, assistant to the director of the production division, Bureau of Aeronautics.

Engineering aspects of certain jobs being performed at Ryan were studied by another group, in charge of Capt. Harry Sosnowski, assistant director, piloted aircraft, Bureau of Aeronautics. He was accompanied by three Marine officers, Col. A. B. Robertshaw, and Lt. Col. R. S. Mickey, both of Division of Aviation Headquarters, Washington; and Col. Jack Cram, Marine Corps Equipment Board, Quantico, Va.



NAVY-MARINE TEAM—High-ranking officers who recently conferred with Ryan executives on engineering aspects of certain projects are shown above. Left to right, William T. Immenschuh, executive engineer; Col. A. B. Robertshaw, Navy Capt. Harry Sosnowski, Col. Jack Cram, Lt. Col. R. S. Mickey, and R. E. White, chief project manager, metal products.

MACHINE TOOLS

(Continued from page 15)

pools at Marietta and Omaha, and reallocation of Air Force tools within industry, if necessary.

Machine tools had their birth in France 200 years ago where the first practical lathe was built. In England, some 25 years later, John Wilkinson developed the boring mill which began a wave of machine tool development.

In rapid succession, the planer, the shaper and modern lathe were invented, and by 1800 Eli Whitney had conceived and put into practice his system of manufacturing interchangeable parts in production of muskets for the U. S. Army.

Whitney demonstrated that a machine tool could fashion thousands of parts, all alike and indistinguishable from one another. Since that date, machine tools have been the key to production.

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Ryan REPORTER

VOL. 13, NO. 2

World's largest external fuel tanks for aircraft are assembled in huge torpedo-like sections at Ryan final assembly area. Exterior of big tank is smooth envelope of seam welded aluminum alloy. Unique design accomplishes ultimate in light-weight fuel package.

BIGGEST WING TANKS

THE largest external fuel tanks known to be in production are coming from assembly lines at Ryan Aeronautical Company. With a record-breaking capacity for carrying kerosene or gasoline, these mammoth containers will bring increased range to combat aircraft.

Given the prime contractor's specification and other data including contours and strut design details, Ryan engineers created a torpedo-like structure which will pack huge quantities of fuel. Cylindrically-shaped, with tapered nose and tail domes, the fuel cells are aerodynamically smooth. More than thirty thousand electric spot welds are used to join the strong aluminum alloy sheets which form their light weight design.

The immense tanks have amazingly few components. No longitudinal members are used in the design and there are very few bulkheads.

From the inception of the design, Ryan engineers have worked closely with the company's production tooling experts to simplify the fabrication of the tank. Electrical resistance welding, in which Ryan has accumulated the industry's most extensive experience, is employed as the principal joining method. All circumferential joints are closed with two rows of spot welds and one row of seam welding to accomplish a gas-tight seam. The single longitudinal seam, running through the individual tank sections, is fusion-welded on automatic Heliarc welding machines. This provides a strong, flat seam which is no thicker than the metal itself and does not require splice plates.

One of the largest projects attempted

←

Tank tail cone is immersed in RACO 34, Ryan Laboratory etch, to remove oxides.

in the aircraft industry with spot welded aluminum alloy, the tank posed a number of perplexing problems for production. First, the size of the structure exceeded standard welding equipment dimensions. Second, the alloy selected did not respond satisfactorily to commercial cleaning compounds so that an acceptable surface resistance would be obtained for certified spot welding. Third, the requirement that the huge containers had to be absolutely gas-tight by welding alone, made exceptional cleaning and welding supervision a must.

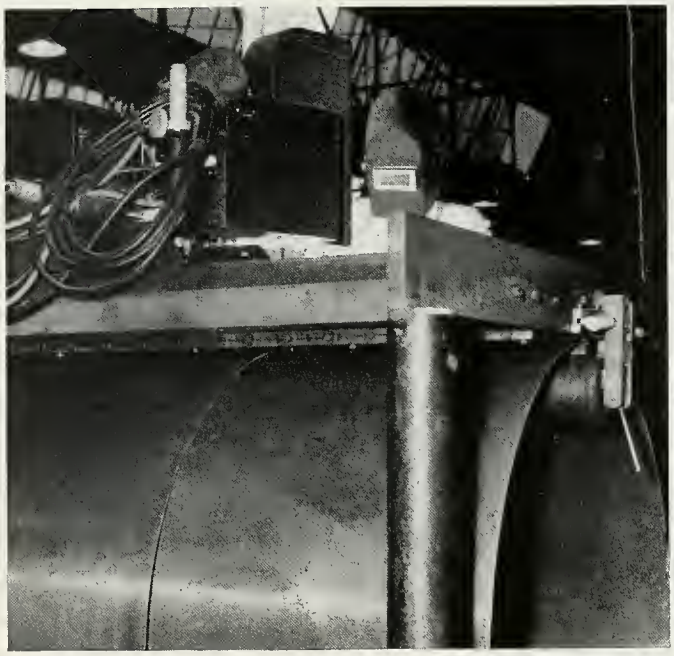
To handle the welding tasks, Ryan plant engineers ordered and installed some of the largest and most versatile equipment of its type. Four pairs of towering seam and spot welding machines were established in the production area. Trained two-man teams were placed on each machine: one to operate the machine and the other to control the feed of the work. With a 60-inch "throat" depth, these big welders handle the work 62 inches from the floor. They can fire 120,000 amperes between sheets which are squeezed together with 10,000 pounds pressure. They can produce more than 200 spot welds per minute and cram nine of them into a running inch.

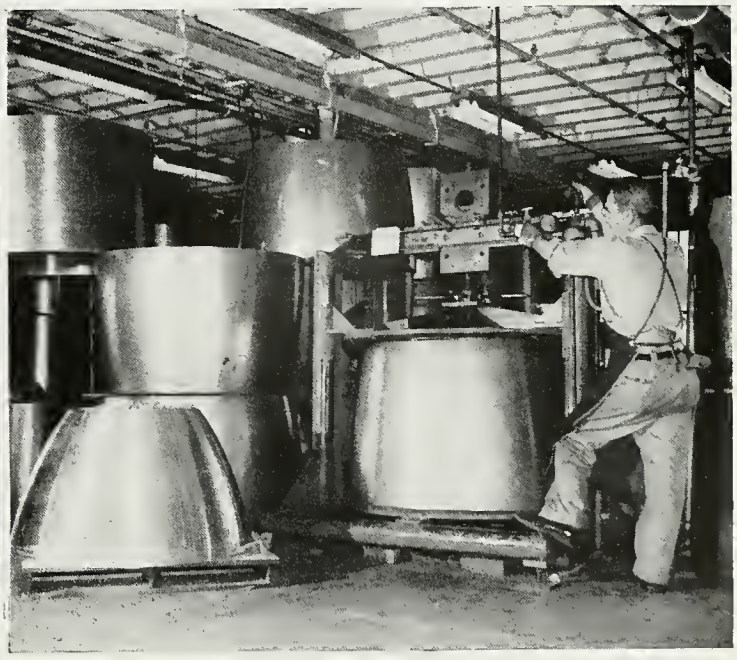
(Continued on page 19)

Rows of invisible fused nuggets, made by huge seam welding machines, form seams in Ryan-built tanks.

Packing a service station-full of fuel, the Ryan-built wing tanks are the largest ever produced

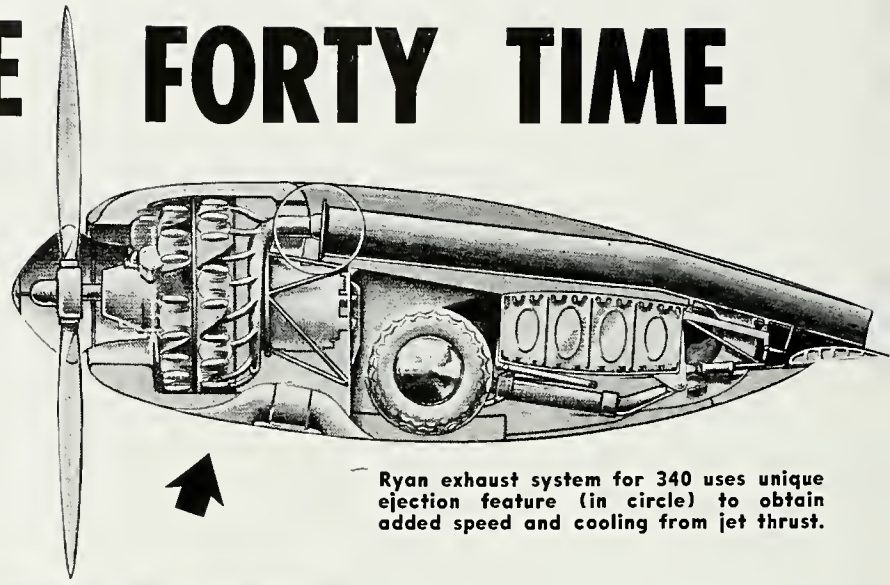
(Left) Automatic heliarc machines fusion-weld large sheets into one-piece continuous tubes for tank body. (Right) Rigid leak-proof specifications, plus large component size, require that tank sections be individually pressure tested to 3½ p.s.i. as tank is built.





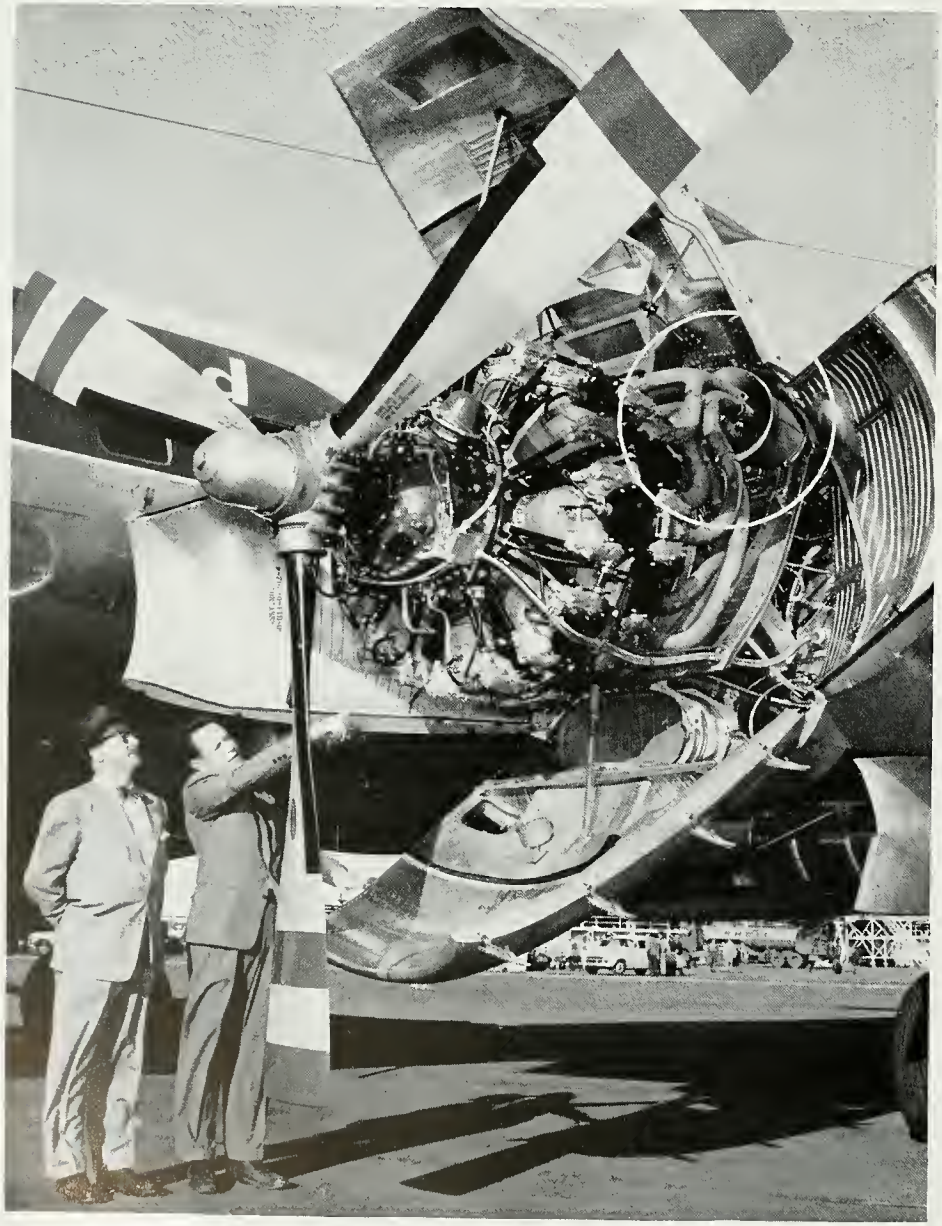
IT'S THREE FORTY TIME

Sired by famous 240, Convair's latest entry is groomed for world's airlines



Ryan exhaust system for 340 uses unique ejection feature (in circle) to obtain added speed and cooling from jet thrust.

With quick-access cowl peeled, Convair and United Air Lines agents inspect Ryan exhaust outlets (in circle) for new 340.



NEWEST airliner to emerge from the industry's showcase is the Convair-Liner 340, the first production model of which—for United Air Lines—made its first flight in January. Created to provide passengers with the high speeds and luxurious comfort associated with four-engined aircraft, the 340 delivers the kind of twin-engine economy which delights airline comptrollers.

Although similar in appearance to its popular predecessor, the 240, the 340 is largely a new airplane with more powerful engines, a larger wing and longer fuselage. Into its development has gone the valuable experience gleaned from the use of 175 240's in more than 800,000 hours of flight logged on the world's airlines. The result is a sleek new airliner which will take off shorter, climb quicker, haul bigger loads and fly faster and farther than the service-tested 240.

The most important change incorporated in the 340 is its wing. Convair engineers found that by giving the 240 wing 13 percent greater area and increasing its aspect ratio from 10 to 12, a number of performance premiums could be realized. First, the CAA take-off field lengths, with equal weights, could be reduced by 1000 feet. Then, gross take-off weight could be increased by a sizable 5210 pounds to a new gross weight of 47,000 pounds. Finally, the new wing provides an additional 150 gallons of fuel capacity which can be translated into longer range.

A great many other improvements have been built into the 340. The fuselage length has been extended 54 inches to allow the installation of four additional seats, bringing seating capacity up to 44. Stepped up performance has been obtained from the Pratt and Whitney

Largest fleet of Convair-Liner 340's will go to United Air Lines which will place 40 of the swift 44-passenger transports in service.

Aircraft R-2800 engines to give the new model 8 miles per hour more speed and swifter rate of climb. The engines will develop take-off power at much higher elevations so that take-off performance at high-altitude airports is enhanced.

Ryan exhaust system engineering has kept pace with this swift progress by the development of an improved structure for handling the hot exhaust gases generated by the engines. Similar to the manifolds which Ryan designed for the 240, the 340 system has been modified to attain a more uniform heating of the metal.

The 340 design consists of eight sets of siamese-type exhaust tubes plus two individual tubes which serve the 18 cylinders of each Convair-Liner power plant. These tubes eject their searing exhaust into two large augmentor tubes which are located at the top sides of the nacelles. As the gases spurt through the unique augmentor tubes to the atmosphere, they accomplish the dual purpose of increasing the speed of the airplane and augmenting cooling of the engine.

Increased airplane speed is derived from the exhaust system by taking advantage of the jet thrust generated by the escaping gas blast. By careful design of cross-section area and contours, it is possible to obtain maximum exhaust gas velocity and resultant jet thrust with minimum restriction to flow, or back pressure, which would reduce engine power. Each exhaust tube then becomes a miniature jet engine developing reactive thrust from the ejected gas. In the 340, this extra source of power develops an additional 375 pounds of thrust or 255 horsepower at cruising speeds.

Ryan has pioneered in this application of exhaust energy to accelerate plane speeds, building one of the first types for Douglas A-20 attack bombers of World War II. After the war, Ryan engineers designed the first ejector-type exhaust system used in commercial service when the Douglas DC-6 manifolds were conceived. This design has been eminently successful both from a standpoint of performance and service life.

By ejecting the exhaust gases into the augmentor tubes, within the engine nacelles, the exhaust energy can be harnessed to perform another valuable task

(Continued on page 24)

(Right) Ryan FR-1 Fireball, World War II Navy fighter, pioneered use of jet pump effect for cooling engine from exhaust.

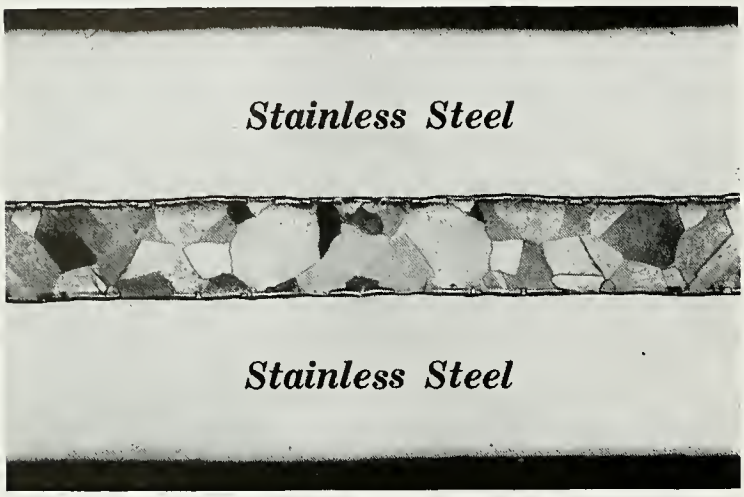
(Below) In Ryan precision jigs, Guy Keller (left) and Arlee Tomberlin (right) line-up the 340 stainless steel manifolds.

A copper "sandwich" may boost jet engine service life and performance by giving heat-resisting alloys better thermal conductivity than ever before.

Called "Rosslyn Metal," this composite sheet material is the development of American Cladmetals Company. To test its high temperature behavior in jet and piston engine applications, Ryan Development Laboratories are building combustion chambers, afterburner vanes and exhaust headers of Rosslyn Metal.

If it lives up to its metallurgical forecast, RM may well contribute to more speed, less fuel consumption and longer life for aviation's jet power plants as well as important benefits for piston-type exhaust systems.

It's hard to conceive two metals which have such dissimilar properties as copper and stainless steel. With their widely separated characteristics of melting point, tensile strength and hardness, it is obvious that their formation into a composite material would be difficult if not impossible. When metallurgists demonstrated that lamellar sheets of stainless steel could



HOT COPPER SANDWICH

Etched Ryon photomicrograph, magnified 30X, showing a Rosslyn metal sandwich of copper between two sheets of stainless steel.

Squeezed together with 100,000 lbs. of pressure, sheets of copper and cladding metal are welded at edges by American Cladmetals.

be bonded to both sides of a copper core, American Cladmetals Company was organized to produce the new material.

Blending the excellent heat-conducting qualities of copper with the exceptional strength and durability of stainless steel, Rosslyn Metal has the highest thermal conductivity of any heat-resisting material. The laminated sheets actually have greater lateral conductivity than pure copper under some conditions of service. Even at temperatures of 1500°F., lateral conductivity compares favorably with pure copper — which would of course oxidize to destruction if exposed directly to such heat.

Rosslyn Metal has a comparative thermal conductivity of 57.2 percent, based upon copper's 100 percent. At the moment that heat penetrates any point of its thin stainless steel outer walls, the copper core quickly and uniformly conducts it throughout the entire sheet. This avoids "hot spots" because heat will penetrate the thin stainless steel sheet in a matter of a second and the copper will immediately spread it over a distance of at least 1,000 times the thickness of the cladding material.

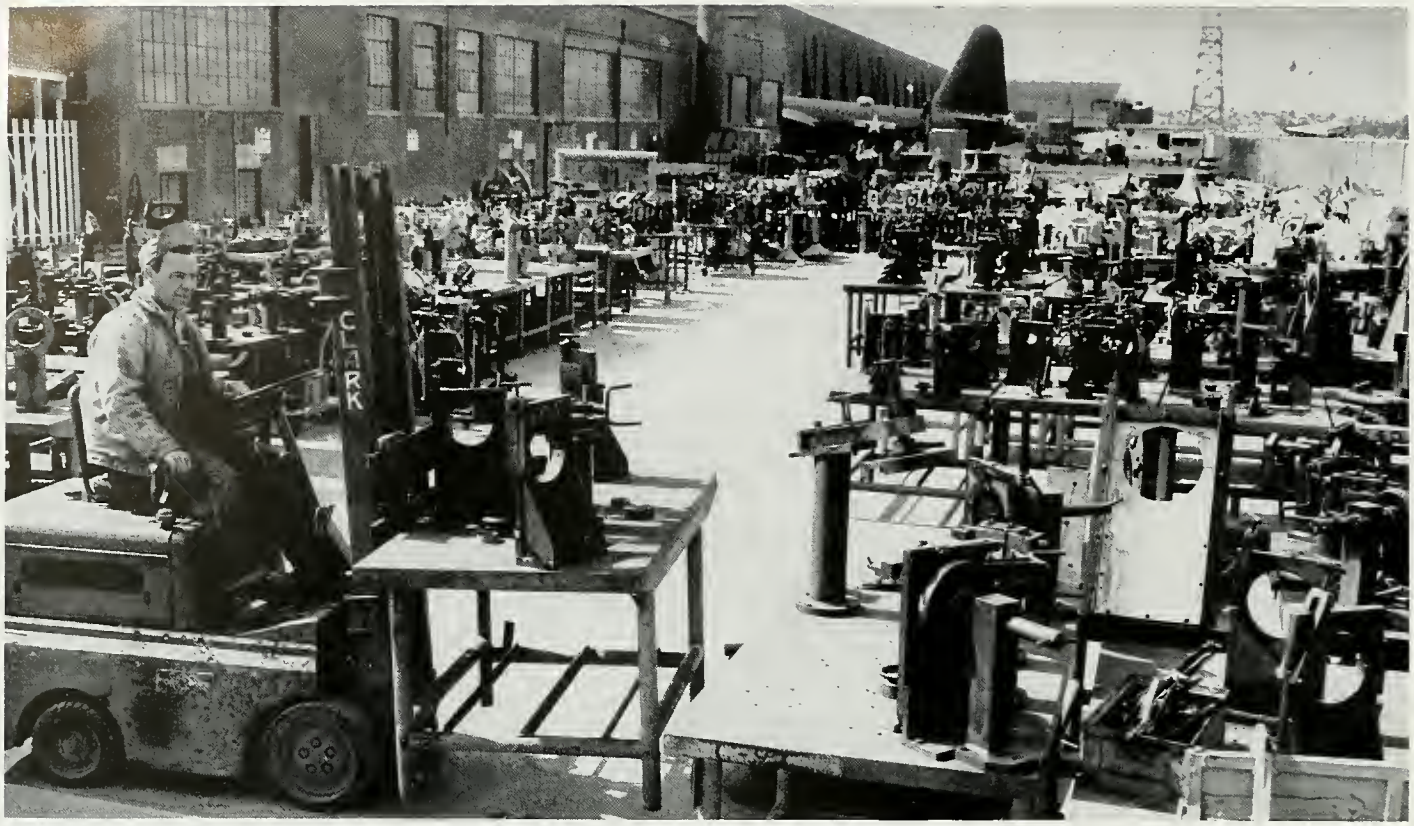
Such good thermal properties may substantially improve performance of high temperature components by eliminating stresses which are incurred between hot, expanded areas and the surrounding, cooler metal. These stresses can produce

(Continued on page 22)

High temperature hurdle for Rosslyn metal are these inner combustion chambers which Ryan has made for jet engine test runs. Charles Swansan prepares them for shipping.

Protective shell of Rosslyn metal is installed on Ryan afterburner rake by Curtis Franklin. Designed to survive in a hurricane of heat, rake contains thermocouple which registers volcanic temperature of exhaust blast through afterburner unit.

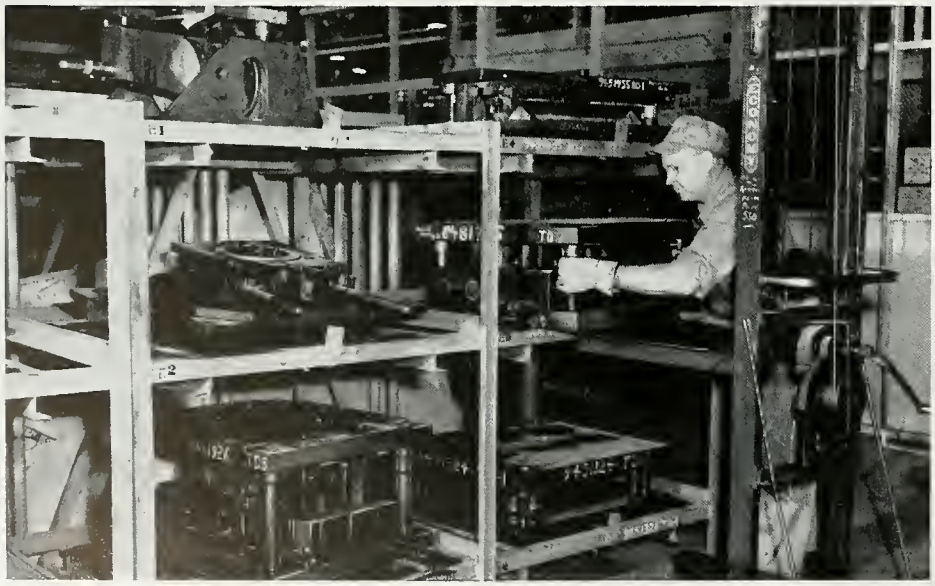
Richard White, Chief Project Engineer, examines Rosslyn metal exhaust headers made by Ryan for Pratt and Whitney Wasp Major engines. Clad with 19-9DL stainless steel, they are being tested on Pan American World Airways Stratacruisers.



Manufacturing fixture for exhaust system component is removed by fork lift truck from storage area to production department.

Cache for Tools

Specially-designed roller racks expedite the movement of heavy dies in Ryan's main jig and fixture crib. Dies slide easily in and out of racks to or from lift trucks.



IT may be a hydro-form block or an emery cloth, a welder's helmet or a dowel pin, a mill cutter or a piece of sandpaper—Ryan's "department store" clerks will come up with what you want when you want it.

The "department store" consists of a network of tool cribs at strategic locations, through which flow thousands of items—soft goods, hardware, perishables, expendables, and articles as "permanent" as anything can be in the aircraft industry.

Most imposing, perhaps, is the main jig and fixture crib, where active dies, templates and hydro-form blocks are stored on a rotation basis. In this area, clerks must account for 9,000 tools worth some $1,800,000.

Records show where every tool is being used to help build the quantity of parts needed in a particular stage of production. Tools are "loaned" out from this crib for the period of time required to turn out the parts, and then are returned for "live" storage.

This is a constantly changing inventory, as active tools drop into disuse with obsolescence or termination of contracts, and as new tools take their place to meet

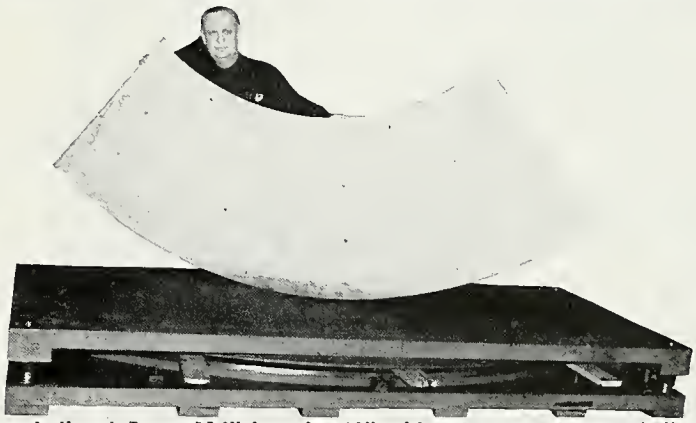
"Makings" of tools—pipes, tubing, bar stock, etc.—comprise huge stockpile.

In this main jig and fixture crib, clerks must account for approximately 9,000 tools worth $1,800,000. C. J. Fitzpatrick, tool control general supervisor, at extreme left.

production demands. But responsibility for inactive tools does not end when they are no longer needed for current work. The government demands that they be kept available for the life of the plane type, and although such tools are being continually scrapped or shipped to the original customer, vast quantities must be maintained.

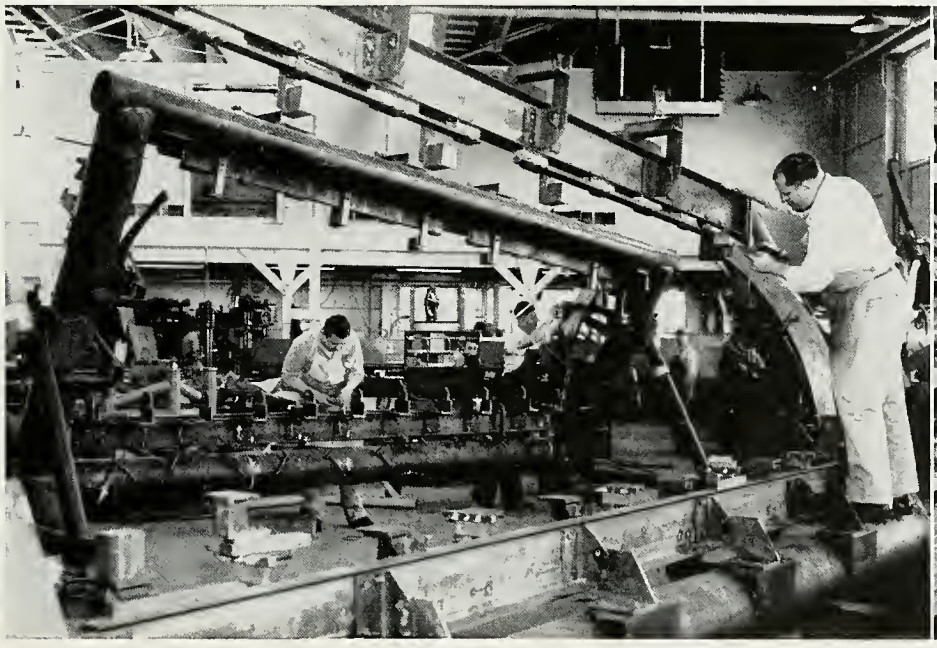
This creates a storage problem, which has been solved in two ways at Ryan. Outdoor cement slabs are used, not only for "dead" items, but for active tools and jigs which are too bulky to be kept

(Continued on page 21)



Largest die at Ryan, 114" long by 49" wide, stamps out cone shells for G. E. jet engines. Larry Boeing displays huge template used with die.

Giant tools like this buck jig being built for C-97 cargo door project are among many thousands of items under jurisdiction of tool crib as soon as they go into operation.



These cutting tools checked by J. Boyer come under "expendable" classification

Last year's "flyingest businessman" among all Navion owners was S. D. Murphy, center, of Indianapolis, being presented an earlier plaque award from T. Claude Ryan. F. V. Osborn, v-p of Murphy's firm, watches.

S. D. Murphy, Indiana manufacturer, gets year's top honors for business use of Ryan Navion

IN a spectacular run "down the stretch," S. D. Murphy of Indianapolis, Indiana, won international honors as Ryan Aeronautical Company's "Flying Businessman-of-the-Year," logging the most hours among 2,000 Navion owners since the contest began in November, 1950. He will receive a handsome engraved gold trophy.

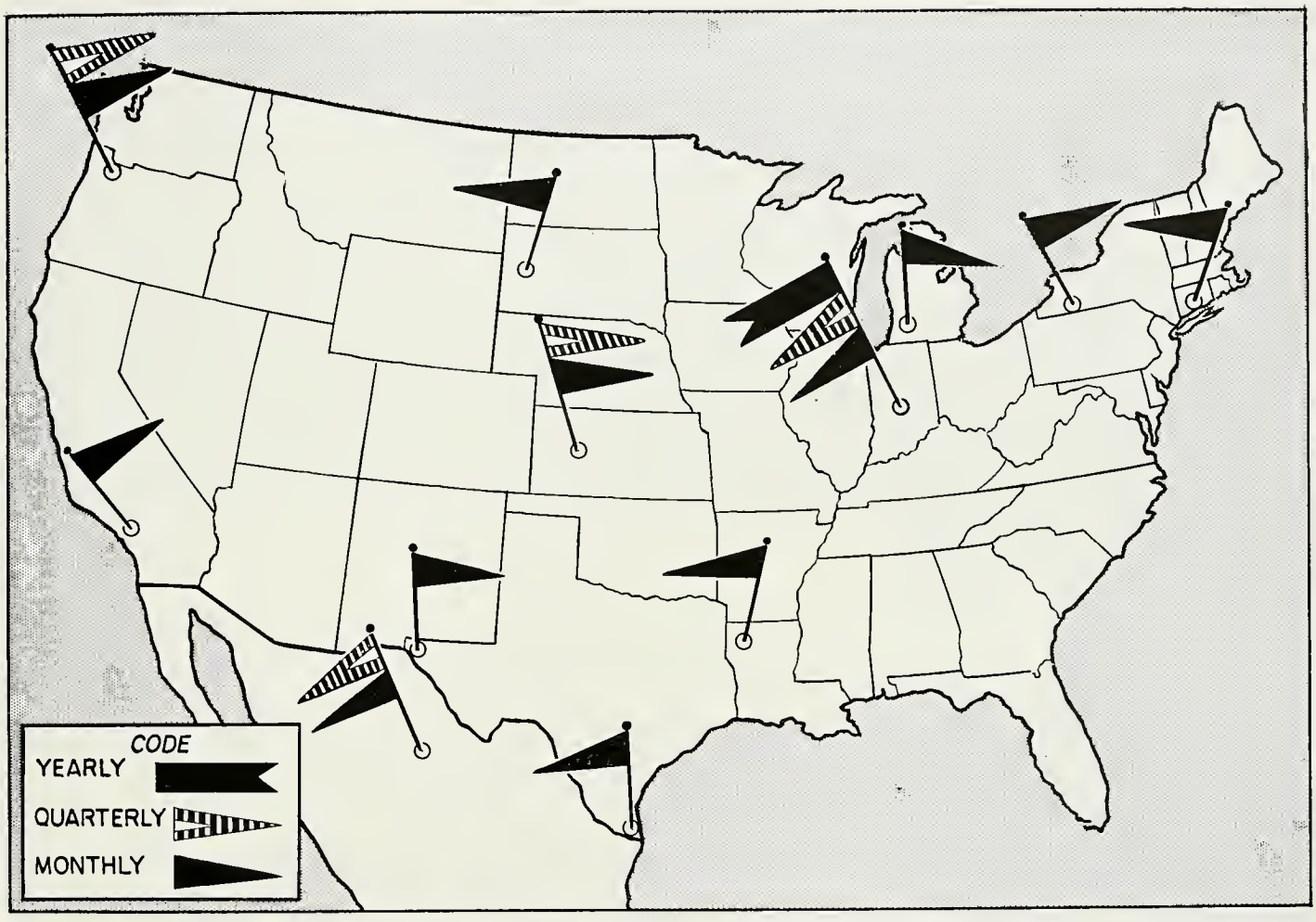
Murphy, president of the Mouldings Division of Thompson Industries, Inc., encountered a strong contender in Lowell L. Hoover of La Crosse, Kansas, funeral director and furniture store manager, who has been mayor of his town.

The final figures showed that Murhpy had spent almost 850 hours at the controls of his Navion during the 12-month period of the contest, with Hoover compiling more than 800 hours. The contest was confined to non-professional pilots who use their Navions for business travel. Planes flown by charter services and fixed base operators, of course, log considerably more than a thousand hours a year.

FLYING BUSINESSMAN-

George S. Patterson, construction company official, was first "Flying Businessman-of-the-Month" when contest opened. He is shown in Navion cabin receiving supplies for delivery to work site.

Elizabeth Shea shows Ryan trophy to be presented contest winner.



Evenly distributed use of Navions throughout U. S. and into Mexico is shown by home towns of "Flying Businessman" contest winners.

OF-THE-YEAR

ion of Lowell L. Hoover (in business suit) carried first load of food clothing sent to flooded Kansas City from any town in Kansas last year.

Indicative of the hot competition between these two leaders was the record for the final month of the contest, when Murphy logged 90 hours and Hoover 87 hours. Their totals during single months have ranged as high as 113 for Murphy and 107 for Hoover.

Both Murphy and Hoover also were quarterly winners—Hoover for the spring of 1951 and Murphy for the autumn of 1951.

Other quarterly champions were George S. Patterson of Portland, Oregon, and Grand Island, Nebraska, construction superintendent for the John L. Hudson Co., builders of pre-fabricated structures, who was title-holder for the winter of 1950; and Howard T. Martin, who gave the contest its international flavor. Martin, who was quarterly champion for the summer of 1951, is a rancher in the state of Chihuahua, Mexico, about 180 miles southwest of El Paso.

Murphy's company is so enthusiastic about the Navion that it operates three of them for its far-flung business transactions. Murphy himself is likely to fly to various cities in the midwest or into the south for important conferences in any one day and be home in time for dinner.

(Continued on page 18)

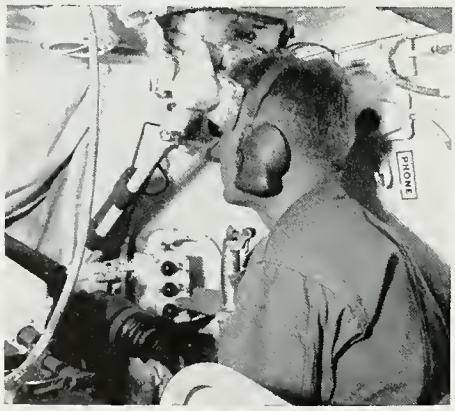
Tank No. 61

Second Lieutenont Jesse O. Giddens, 1st Platoon Leader and commander of No. 61 prepares to load his .50 cal. machine gun.

The first-hand account of Continental-powered M-46 tanks in Korea, written especially for Ryan Reporter

by A. D. Bruce, Jr.

Captain A. D. Bruce, Jr.



It's close quarters inside the tank for Sargeant Kardynal as he sights his gun through the periscope in the M-46 tank.

Because we had never seen any articles which gave proper recognition to the crews who man tanks in combat, the editor, on a trip to Washington, some months ago, asked Army Ordnance if it could supply such an illustrated feature for Ryan Reporter.

We felt Ryan employees, who build exhaust systems for the Continental AV-1790 engine which powers the M-46 General Patton heavy tank, would like to know something of the role, importance and life of tankers. We wanted a first-hand story which had the touch and smell of combat; that told the important details of each man's job in the cramped quarters of the tank hull.

Through Major Michael J. Strok, Army Ordnance officer, who had written a personal account of the combat operation of Ryan Navion L-17s in Korea, and Lt. Col. Thomas W. DeMint we were put in touch with Capt. A. D. Bruce, Jr., who was leaving in a few days for Korea.

The result is this fine article by Capt. Bruce, and excellent photographs by Sgt. John D. Grigg, prepared especially for readers of Ryan Reporter.

Assistant Gunner, Pfc. Loven K. Knutson passes a 90mm White Phosphorous Smoke shell to the gunner, Sargeant Rudolph E. Kardynal for loading in the ready rack.

Driver of No. 61 is Sargeant John A. Calhoun who adjusts the track of the 47 ton steel tank.

The entire five-unit team pitches in to man the ram-rod when cleaning the 90 millimeter gun after a firing bout wth the enemy.

TANK, Medium, M-46, USA 30163-381, U. S. Army Serial No. 525, and assigned No. 61 by "D" Company, 6th Tank Battalion, attached to IX Corps, was more than a hulk of steel stamped with various confusing numbers.

It was both home and workshop for five men. Yes, five men would heat their rations over its exhaust, sleep on its back, bathe beside it, and fight from it.

These five formed a compact little unit which was taught to fight as a team. Leader of the team was 2nd Lieutenant Jesse O. Giddens from Perry, Florida. He joined the Regular Army 10 years ago when he was 18 and had been a Master Sergeant until he got his battlefield promotion.

Second-in-command was the Gunner, Sergeant Rudolph E. Kardynal, originally from Karkov, Poland, and now from Springfield, Massachusetts. He arrived in the United States in 1947, when he was 20 years old, and in 1948 joined the Regular Army. Driver of No. 61 was Sgt. John A. Calhoun from Laona, Wisconsin. Another Regular Army man, Calhoun has been in since 1947, when he was 17 years old.

Next man on the team was PFC Loven K. Knutson, the Assistant Gunner and radio man. He hailed from Inwood, Iowa, and is now 25 years old. Corporal Emery Dotson, 19, from Majestic, Kentucky, completed the team. He was BOG Gunner and Assistant Driver.

Illustrative of their combat job is an action that took place just a year ago—on February 15th and 16th, 1951.

The whole show started on the 13th with a field telephone jangling at their company command post and a voice barking: "You are to move up and relieve the 23rd Infantry and the French Battalion at Chipyong-ni — they are completely surrounded. You are to get through at all costs." ". . . at all costs." ". . . at all costs." Those three short words packed a tremendous amount of meaning to the crew.

Tank No. 61, as lead tank of the 1st

(Continued on page 23)

In camp, Corp. Emery Dotson, Sgt. Calhoun and Sgt. Kardynal take time out for chow.

The exhaust of the lead tank of the First Platoon does double duty and serves as a portable stove for heating up C-rations for the hungry crew when lunch time arrives.

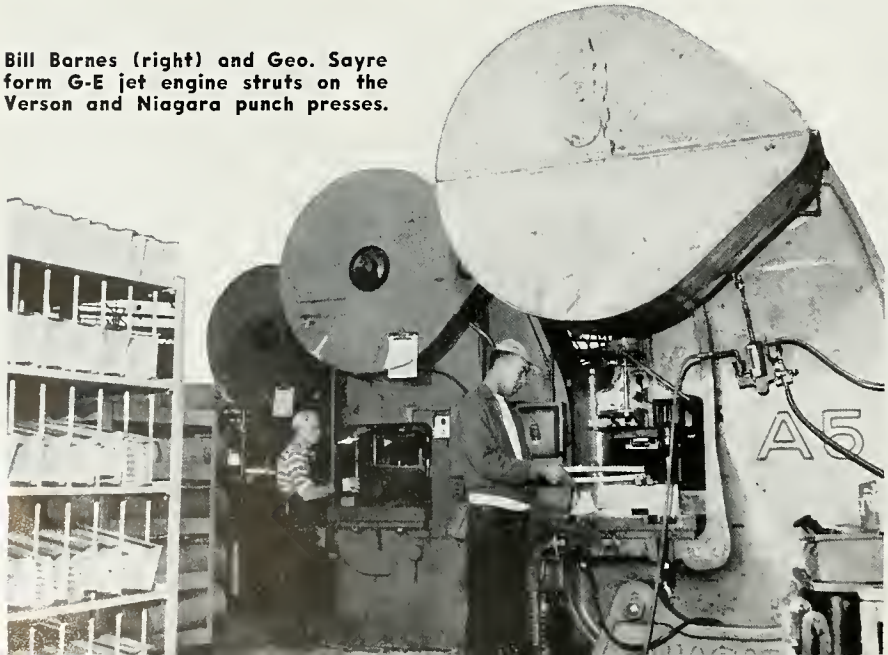
Photographed in Korea

by

Sgt. John D. Grigg

Besides the new 600-ton Warco (left) Ryan's "press room" contains two 250-tonners, a 1,000-ton hydra press and two new 400-ton Warcos

Bill Barnes (right) and Geo. Sayre form G-E jet engine struts on the Verson and Niagara punch presses.



THE
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Ryan's huge pre
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FOUR huge, new Warco presses have been installed in the Ryan factory to step up production of high temperature structures for jet engines. Capable of exerting up to 600 tons pressure at a stroke, these mammoth machine tools can stamp out parts for exhaust cones, transition liners, aft frames and other jet components at amazing speed. Largest of the presses—a 230,000-pound giant—is the biggest piece of equipment ever installed at Ryan.

The arrival of the Warco presses highlights a production trend which is influencing the aircraft industry. Greater emphasis is being placed upon the design and fabrication of large, single-piece components, which can be pressed out in huge machines, rather than forming these structures by joining innumerable small parts. The old era of "bits and pieces" is giving way to this newer philosophy which is limited by the availability of big presses and new designs. Ultimately, this trend could save millions of manhours and many tons of machined materials by stamping out large aircraft components as fenders are pressed for automobiles.

An example of the benefit of this trend is illustrated in the use to which Ryan is putting the Warcos in fabricating exhaust cones for General Electric J-47 jet engines. Formerly, the large stainless steel skins for these cone assemblies had to be cut out in patterns by both power shears and rotary

(Continued on page 20)

At the controls of the Erco Stretch Press, E. R. Cunningham (left) pushes a huge die into a sheet of aluminum alloy to stretch-form a C-97 Stratofreighter re-fueling pod.

Checking their route through Mexico prior to takeoff on 4200-mile Navion service clinic trip are, l. to r., A. P. "Pete" Gailey, Lycoming Company representative; W. K. Balch of Ryan; and Francisco "Pancho" Waltz, Navian distributor for Mexico.

HOBNOBBING with governors, Air Force generals and the number one businessmen of their communities is routine when you're conducting a Navion service clinic in Mexico.

This was discovered by Walter K. Balch, Ryan airplane service manager; A. P. "Pete" Gailey, Lycoming Company representative, of Williamsport, Pa.; and Francisco "Pancho" Waltz of Mexico City, Ryan Navion distributor for Mexico, when they made a ten-day, 4200-mile swing around the southern republic recently in a Navion Super 260. It was the first Ryan Navion service clinic ever conducted outside the United States and climaxed a year in which Balch and William "Doc" Sloan, traveled some 40,000 miles to all sections of this country.

In Hermosillo, picturesque capital of Sonora, the trio just missed Governor Ignacio Soto, who was on a trip with his Navion, but they conferred with his sons regarding operation and maintenance problems.

Nestled in a green valley in the foothills of a majestic mountainous area in the state of Nayarit, near the west coast of Mexico, is Tepic, where the Navion belonging to Governor Gilberto Flores Munoz was checked, as was the Navion owned by the town's most enterprising citizen, Jose M. Menchaca, owner of plantations and a sugar cane processing mill.

More than a dozen Navions were given the once-over in Mexico City, with Waltz piloting the craft on air checks,

FOREIGN SERVICE

Mexican service clinic itinerary touched Hermosillo, Mazatlan, Tepic, Mexico City, Acapulco, Zimapan, San Luis Potosi, Durango, Torreon, Chihuahua, and Juarez. The planes checked belonged to business men, ranchers, governors, and military leaders.

Jose M. Menchaca, owner of plantations and sugar cane processing mill at Tepic, reviews with Balch inspection report of condition of his Navion. Also checked in Tepic was plane belonging to Gilberto Flores Munoz, governor of Nayarit state.

and Balch and Gailey giving them thorough inspection on the ground. One of these Navions, owned by Enrique Corcuera, Jr., wealthy Mexico City property owner, was credited with a topnotch performance in the Mexico City-Acapulco air race for private planes, conducted during the week-end Balch, Gailey and Waltz arrived in the capital.

Two of the Navions checked in Mexico City belonged to General A. Cardenas Rodriguez, chief of the Mexican Air Force and General Enrique Calderon, another Mexican Air Force officer.

A round trip to Acapulco during the air race preceded three days of intense activity at the Mexico City airport. Crowded into this short time was a side

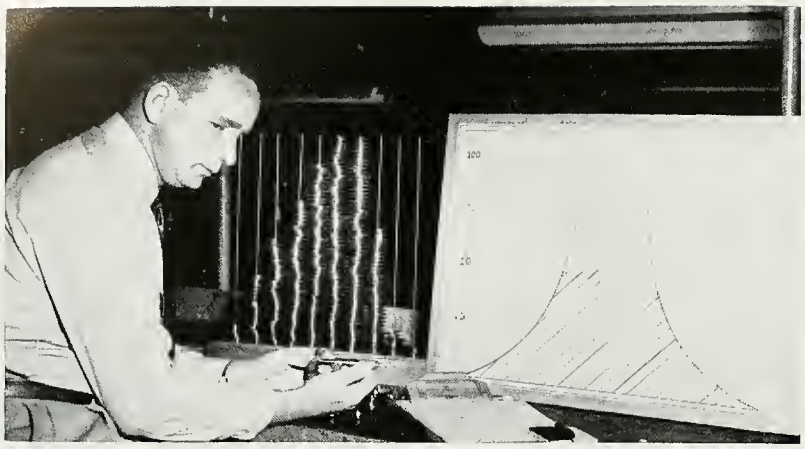
(Continued on page 17)

At Mexico City, giving once-over to the Navion of Walter Purple (standing on ground), is "Pete" Goiley, Lycoming representative.

Navion belonging to Enrique Corcuera, Jr., second from left, placed high in Mexico City-Acapulco air race, which occurred during Navion service clinic period. Gailey, left, and Balch, right, congratulate Corcuera and woman companion on flight.

Robert Ramsden, right, greets Walt Balch upon his arrival at Zimapan, 100 miles north of Mexico City, where he has his ranch and mining property. Balch had flown Ramsden's Navion home after it had been serviced by Waltz in Mexico City.

Scene at Acapulco airport at conclusion of air race from Mexico City. Note the summer clothing in tropical heat of mid-November.



Bernard Carr, quality control analyst, compares the frequency distribution pattern of parts manufactured by subcontractor, at left, with chart of "normal curve," at right, in statistical quality control study at Ryan plant.

PREDICTABLE ERRORS

The "Law of Probability" adapted to manufacturing processes prevents costly "post mortem" inspection losses

S.Q.C.—initials of growing significance to modern industry—are being heard increasingly at Ryan Aeronautical Company.

S.Q.C. stands for Statistical Quality Control, based on principles conceived as long ago as the 17th Century. But not until recent years has S.Q.C. demonstrated its potency in the control of quality in almost every type of industry.

So generally accepted is S.Q.C. becoming that courses in Statistical Quality Control have been sponsored by the national office of production research and development.

At Ryan, a program for the development and expansion of S.Q.C. has been launched and already many advantages are being realized from its application by the use of sampling inspection in the Receiving Inspection Department. Under the supervision of A. S. Billings, chief inspector, S.Q.C. is being developed by C. D. Wilcox, salvage engineer, and B. J. Carr, quality control analyst. Plans are being made for the expansion of the program, wherever applicable, throughout the plant.

At the core of S.Q.C. is the "law of probability." For instance, if a coin were to be flipped ten times, and each time it turned up tails, you'd become suspicious and demand examination of the coin. Such an "unnatural" phenomenon would be due to an assignable cause—probably a coin with tails on both sides.

Adapting the law of probability to manufacturing, we accept a natural amount of variation in a process. If a stop was set on an automatic shear to cut strips one inch in width, it would be natural for the width of the strips to vary several thousands of an inch. However, if the width should suddenly vary one eighth of an inch, the manufacturer would realize that an assignable cause was responsible. He would immediately examine the machine to locate the source of the unnatural variation.

As long as the variation is within the machine capability, it is accepted as natural and the shearing process is recognized as being in statistical control. As soon as this expected variation is exceeded, the process is deemed out of statistical control, and the machine is stopped. This is a simple example of the law of probability applied in the form of Statistical Quality Control.

The second principle used in S.Q.C. application is the "normal curve of frequency distribution." An example can be drawn from everyday life. The natural assumption is that the majority of men over 21 in this country are between 5′ 6″ and 6′ tall. Above 6′, the number of men for each one inch graduation would decrease. The same would be true below 5′ 6″.

Suppose a bench were to be marked with one-inch graduations beginning from the left with 5′ and going across the right to 7′. Each man checked in a physical examination would write his height on a slip of paper and place it over the marking corresponding to his height. The stacks of papers over the 5′ and 7′ markings would be very small. The stacks would increase in height as the normal height markings would be approached from both ends of the bench. This would form a "normal curve" quite similar to the figure shown to the right in the illustration above.

Applying this to factory processes, a frequency distribution curve is being formed in the illustration, at left, by the measure of flange thickness in parts for jet engines. The allowable range is .037″ to .047″.

Vertical rods are set up, marked from left to right in .001″ graduations within the allowable range. The thickness is measured and the part is placed over the rod corresponding to the flange thickness. It is noted that the parts form a distribution similar to the "normal curve" on the chart at right.

By such means, S.Q.C. determines the amount of variation to expect in a process, and whether the process is capable of maintaining a dimension within the required specifications.

From these simple principles, S.Q.C. has developed charts and tables which can warn when defective parts are about to be made, and whether the machine or the operator is at fault. This is in contrast with "post mortem" inspections conducted too late to prevent waste. The "watchdog" technique of S.Q.C. guarantees a minimum of defective parts through constant guarding against variations beyond control limits.

UNIFORM charts give an exact picture of existing conditions. Sub-normal operations are separated statistically so that the plant executive knows at a glance what requires attention. No mass of figures or reports is needed.

The major value of S.Q.C. is its control of quality *during* production to *prevent* turning out defective parts. Scrap and rework are reduced to a minimum. Statistical limits, which are not to be confused with engineering tolerances, may be used to hold an operation within its normal range, if it is known what this operation can produce.

S.Q.C. definitely establishes limits for

(Continued on next page)

normal operation. Without these limits it is impossible to tell whether a fluctuation is normal or a sign of impending trouble. S.Q.C. advocates say it can be applied, not only to control of quality, but to such other factory problems as absenteeism, overtime, order control, shortages, departmental activities, etc.

Quality control has become so important in modern factory methods that a national organization of control specialists has been established to improve and expand S.Q.C. methods and to encourage personnel to enter this field. It's the American Society for Quality Control, and a San Diego chapter has just been formed, with 96 charter members, including 13 from Ryan. Wilcox is treasurer.

FOREIGN SERVICE

(Continued from page 14)

trip by Waltz to Zimapan, 100 miles north, in a Navion being returned to its owner Robert R. Ramsden, who sent it to the capital to be serviced by Waltz. Balch and Gailey accompanied Waltz in their own Super 260 and the three returned to Mexico City after an enjoyable visit with Ramsden at his ranch and mining property.

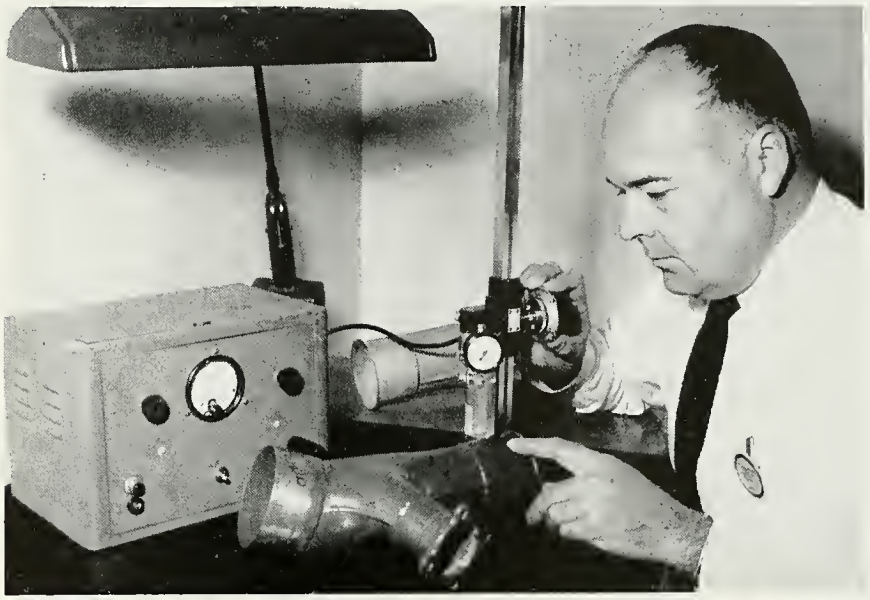
En route home from Mexico City, the touring trio stopped at San Luis Potosi, Torreon, Durango, Chihuahua and Juarez, encountering low ceilings and snowstorms on the last leg of their journey. Waltz returned to Mexico from El Paso by commercial airline; Gailey headed for his home in the east and Balch flew alone to San Diego.

On a clear, cold day with an unusual tail wind from the east, Balch took the Super 260 to 12,000 feet and flew 550 miles non-stop from El Paso to El Centro, where he refueled. He could easily have made the entire distance into San Diego without stopping but an expected storm on the coast suggested the desirability of full tanks on the last leg of the homeward flight.

Balch's principal advice to those planning an air tour of Mexico: If you aren't personally acquainted with the language and customs of the country, take a companion who is. The presence of Waltz expedited dealings with many an official — transactions which might otherwise have been prolonged.

Also, when required to land at small fields, make a low pass or two to look over the landing strip for possible rough areas and holes. If you trust to luck, you can get into trouble.

And, advises Balch, try the snails in Mexico City's French restaurants. You'll be surprised. You might even enjoy their taste.



William Cockrell, Chief of Development Laboratory, uses Ryan's new machine to measure the thickness of ceramic coating on exhaust header for Stratocruiser.

New Gauge Detects Ceramic Thickness

The thickness of Ryan ceramic coatings can now be measured within .0005" accuracy by a new instrument which has been built by the Ryan Development Laboratory. Designed by the National Bureau of Standards, the new device provides a nondestructive method of determining the gauge of protective coatings applied to nonmagnetic materials. Fast and reliable, the technique employed can be used with curved surfaces as well as flat areas.

Ryan reseachers will put the new instrument to valuable use by analyzing ceramic coatings on Ryan components which are in actual airline service. With 2000 hours of flight test on Pratt and Whitney R-4360 engine headers, fabricated from various metals and coated with Ryan ceramics, laboratory analysts have a rich field to assay. In addition to these Stratocruiser engine parts, Ryan is producing ceramic coated components for 240 Convair-Liners, Douglas DC-6 airliners, Boeing C-97 and B-50 military aircraft and Continental-powered General Patton tanks. These assemblies will also provide excellent opportunities to correlate optimum ceramic thicknesses with maximum service life.

The instrument consists of two parts: a plastic test head in which an electro-magnetic probe coil is embedded and an inductance balance indicator which utilizes a galvanometer. Protruding through the coil is a slender plastic rod which is attached to a dial indicator gauge. This rod is free to move axially and its displacement is indicated by the gauge. The inductance balance unit incorporates an impedance bridge which can be adjusted by potentiometers to bring the galvanometer to zero reading when the electrical balance is attained.

Principle involved is the well-known change in inductance of a coil when it is brought in proximity to a metal surface. The metal acts as a sort of short circuiting device which critically affects the coil's inductance over very short distances. Presence of the ceramic material has no appreciable effect on the field at the frequency used.

First step in the use of the instrument is to calibrate it with an uncoated sample of the same metal as that which is ceramic coated. The probe coil is placed against the metal surface with the plastic feeler rod in contact. The dial indicator is set to read "zero." The current is turned on and the inductance of the coil is established as a reference by adjusting the bridge until the galvanometer also reads "zero."

Then, the coil is transferred to the surface of the ceramic coated part. Its distance is adjusted until the galvanometer reads "zero." This will occur when the coil is the same distance from the conductive metal as it was when the calibration was made. At this point, the plastic feeler rod will be displaced an exact amount equal to the thickness of the ceramic coating. This distance can be read directly from the dial indicator gauge in divisions of .0001".

The process lends itself to the measurement of any nonconducting coating such as ceramic, paint, plastic or paper.

FLYING BUSINESSMAN-OF-THE-YEAR

(Continued from page 9)

On a typical business day, as described in Murphy's flight log, he might leave Indianapolis in the morning, pick up a couple of passengers in Atlanta, Georgia, go to Valdosta, Georgia, site of another of his corporations, transact business over lunch, and fly to Jacksonville, Florida, for another conference. Enroute back to Indianapolis, he would stop at Atlanta to leave the two passengers and have dinner with them. Then, continuing to Indianapolis, he'd be home in plenty of time for a good night's rest.

Navions are considered essential to the conduct of Murphy's business, which is the production of trim for automobiles, refrigerators and other appliances.

"The trips we make in one day, with a noticeable increase in efficiency and ability to give better service to customers, could not possibly be done except with a private plane like the Navion," says Murphy. "Ground transportation is out of the question, and airline schedules don't fit our travel patterns. Even during winter weather, there are few occasions when trips are interrupted for these year-round business planes. And, of course, night flying is frequently done in good weather."

HOOVER'S use of his Navion has been extremely varied. One of its most spectacular missions last summer was the transportation of food and clothing to flood victims in Kansas City, when other forms of transportation were washed out. In his business, Hoover flies the Navion on furniture buying trips, and employs it as an ambulance and flying hearse. He uses the plane considerably to take his daughter back and forth from the University of Kansas, where she is a student.

Hoover's Navion provided the first load of food and clothing to the isolated Kansas City area from outside communities when he managed to land at the only open airport near the city with more than 755 pounds of such commodities. Altogether, he flew 37 hours hauling supplies and persons in flood stricken parts of Kansas while the transportation system was crippled.

Patterson clings to the increasingly popular belief that winter need not be a deterrent to abundant usage of business planes. He has flown six hours every business day during the winter, when personal flying by tradition is supposed to slacken off in his part of the country. This tabbed him as the first "Flying Businessman-of-the-Month" during the contest's first month in November, 1950, as well as "Flying Businessman-of-the-Quarter."

In 1949, Patterson's employer, the John L. Hudson Company, of Portland, Oregon and Grand Island, Nebraska, constructors of pre-fabricated grain storage bins, provided him with a Navion to direct a big job in Nebraska for the U. S. Department of Agriculture. The company discovered it could dispense with the services of six $150-a-week field superintendents as Patterson kept in close touch with more than 50 building sites by flying the Navion. He was usually accompanied on his swing around the construction locations by loads of nails, bolts, screws, and other building necessities. Through use of the Navion, he kept in daily touch with construction progress. When he didn't land, he frequently flew low enough to drop blueprints, specification sheets, mail or even the payroll.

When business pilots like Patterson land, they may be confronted with alfalfa over a foot high or fences that are only 500 feet apart. The Navion's quick, steep takeoff and short landing characteristics are indispensable in such conditions.

MARTIN, the "Flying Businessman" winner for last summer, is a 30-year old rancher who has interests in three ranches in Chihuahua, Mexico. One of the primary uses of the Navion is to link the ranches. But Martin is also a major stockholder in a meat packing plant in Casas Grandes, Chihuahua, and he flies there, as well as to other houses in the state.

Frequent trips are made in the Navion to El Paso to pick up supplies, transact business, and have maintenance work done on the plane. Martin also has interests in Albuquerque, New Mexico, and Fort Collins, Colorado, and makes flights to those cities from his ranches. So dependent is he on his Navion for transportation that in recent years he has had no automobile equipment whatsoever on his ranch. Little wonder. The Navion takes him from his ranch to El Paso in 1 hour, 5 minutes—a trip which would require at least 12 hours by car over tortuous road in good weather and much longer in bad weather.

Martin is choosy about his private planes. He was an Air Force major in World War II, when he flew 2,000 hours in the Pacific area in a P-47 Thunderbolt. He holds the Distinguished Flying Cross and other decorations.

Honors in the "Flying Businessman" contest were shared with the above quartet by eight other monthly winners. They are:

Hal W. Harman, welding company president of El Paso, Texas, December, 1950; Dr. E. W. K. Andrau, geologist, oilman, rancher and farmer of Shreveport, Louisiana, February, 1951; James C. Thomas, tool and die company president of Pasadena, California, March; Ivan E. Landstrom, jewelry manufacturer of Rapid City, South Dakota, June; O. George Tobey, chick hatchery service company president, Avon, Connecticut, July; Kenneth M. Guinnip, oil field equipment company employee of Olean, New York, August; David W. Simpson, mining company president, Brownsville, Texas, September; and LeeRoy Elkins, motor express company president of Kalamazoo, Michigan, October, 1951.

Japanese Engineer Visits Ryan Plant

News of the Ryan Navion's excellence of performance has traveled far and wide and attracted the notice of one of the oustanding aeronautical engineers in Japan.

Recently, R. Arizaka, former Managing Director of the Kawanishi and Hitachi Aircraft Companies in Japan, arrived at Ryan to obtain technical data on the Ryan Navion. A graduate of M. I. T., Arizaka is now associated with Nozaki and Company, 60-year-old import-export company in Japan, which has recently added an aeronautical division.

Arizaka explained that his company is interested in obtaining distributor sales rights for selected American business planes and helicopters. Walter Locke, assistant to the president (above left), discussed details of Ryan Super Navion 260 with Arizaka.

BIGGEST WING TANKS

(Continued from page 1)

SPECIAL equipment was needed to feed the work to the welding machines and Ryan devised a system which has proved its practicability. Tank sections are loaded on steel dollies by means of an overhead monorail system, using electric hoists. The dollies are rolled to the welding equipment on steel tracks which are carefully located to feed into each machine. Rotation of the circular sections is accomplished by rollers in the dollies and a hydraulic cylinder is installed in each dolly to swing the sections from one side to the other, at one end. Connected to a hand control, which is operated by one of the machine's team members, it is possible to yaw tapered sections as they are rotated and produce straight weld seams over tapered surfaces.

An alloy of aluminum without cladding is used in the tank project because of its high strength. Due to high ductility, this alloy is also desirable because it is adaptable to resistance welding. However, it is difficult to clean thoroughly and none of the commercially available compounds would clean it uniformly. They produced a "spotty" removal of oxides which is more detrimental to good spot welding results than a uniformly high surface resistance because machines cannot be set for consistent operation.

In the Ryan development laboratory a new cleaning agent, RACO 34, was developed which removes all oxides with smooth uniformity. The cleaned surfaces have a low surface resistance which is maintained for longer periods. The process is not critical, giving the same good results with immersion periods varying as widely as two to twenty minutes. Daily charts of surface resistance show that a consistent figure running between 10 and 15 microhms is attained. This is well below the required 50 microhm limit specified.

BECAUSE of the nature of resistance welding, a major concern to Ryan production planners was the requirement that the big tanks be made leak-tight by welding alone. Unlike rivets, spot welds cannot be repaired or replaced if they are seriously defective. Also, their strength is critically keyed to the condition of the surfaces welded and the behavior of the welding equipment. One grease spot, or foreign particle, can cause welding resistances and temperatures to zoom and produce an explosive melting of metal with a resultant hole in the sheet.

Consequently, exacting care is taken to prepare the sheets and to govern the performance of the machines. All aluminum alloy is welded within 24 hours after thorough cleaning in near-by tanks. Test samples are taken from the machines each hour and subjected to tensile pull test of 1200 pounds. Regular X-ray examinations are made from sample spot weld pieces, also, to check the microstructure of the cast weld material. In specially-made Ryan jigs, each tank section is individually pressure tested with 3½ pounds per square inch pressure to find any leaks which may exist.

The result of the careful planning of this tank project, from the engineering conception through all phases of production has been most gratifying. Large numbers of the tanks have been produced and none have been rejected because of defective design or workmanship.

Gun With No Bullets

Ryan plant engineers have harnessed the Linde heliarc spot welding gun to a mobile machine which multiplies its usefulness. The Ryan-designed equipment package can be rolled to any production point and placed in operation within a matter of minutes.

Heliarc has many advantages for spot welding. It is exceptionally clean and does not involve the use of flux. Consequently, there is no flux removal problem. It does not produce a build-up or erosion of metal, characteristic of arc welding, but leaves a smooth surface which requires no grinding or finishing. Heliarc spot welds can be run between seam welding wheels without surface preparation.

The Linde pistol-grip welding gun brings the advantages of heliarc welding to the spot welding process because it provides accurate timing control not possible to achieve manually. It is extremely light weight and compact and can be used for spot welding sheet metal and machined members in their assembly jigs because it spot welds components which are accessible from only one side. This eliminates the time-consuming job of removing these structures to welding machines and permits the spot welding of large or irregularly-shaped assemblies which would not be accessible to fixed electrodes.

The new Ryan machine, which was suggested by Ray Ortiz, Manifold Production Superintendent, provides the Linde gun with all of the necessary facilities in a compact, mobile unit. It incorporates a timing control, DC generator, argon gas supply and 40-gallon water tank and pump. Operaton of the equipment is completely automatic from the time the operator presses the trigger.

First, argon gas flows through the cable to the gun and out the barrel, blanketing the weld zone with a protective gas envelope. Then, a DC current, with a superimposed high frequency AC current, is fed to the gun's single tungsten electrode. The arc strikes for an exact interval which is sufficient to cause the metals to heat and flow together. At its termination, the argon gas continues to flow for a few seconds to protect the electrode against oxidation while still hot. Cooling is provided by water which is circulated through the gun by an electric-driven pump from a 40-gallon supply.

Ryan is using the new machine to spot weld Fairchild C-119B exhaust hoods and machined rings in assembly jigs prior to seam welding. These stainless steel components are used on the new Wright R-3350 compound engine where they are fitted to the turbine nozzle boxes. A number of similar production jobs are planned to take advantage of the speed and flexibility of the new equipment.

THE BIG SQUEEZE

(Continued from page 13)

cutters. Then, they were manually drilled with radial-arm drills and placed in punch presses where special dies blanked the cut-outs for fittings. After these operations, the holes were de-burred and the sheets were rolled and welded.

One hour of labor and a number of machines, dies and individual handlings were required to prepare each skin prior to rolling. Now, the same results are accomplished in a fraction of the time by using the Warco press. Precision steel dies, weighing six tons and costing thousands of dollars, are placed in the spacious 4'x9' bed of the largest Warco. The stainless steel sheet is located on the die and—Presto! 600 tons of crushing force blanks and pierces the complete sheet with utmost precision. De-burring is kept to a minimum because the close-fitting dies shear cleanly with little burr residue.

Ryan production planners are similarly capitalizing upon the flexible power of the new Warco presses to streamline the production of J-47 combustion chambers, transition liners, aft frames and afterburner parts. The big machines will be used to form, draw and emboss these components as well as blank and pierce them. In some cases, four-stage dies can be used in a single press bed so that each stroke of the ram can perform four different press operations.

Manufactured by the Federal Machine and Welder Company of Warren, Ohio, the big Warcos incorporate the latest press design concepts. They are constructed from rolled steel, box-type weldments and are actuated by an unusual eccentric gear drive. In contrast to crank and eccentric shaft presses, the Warcos transmit their tremendous power through straight shafts and twin-driven eccentric gears, thus eliminating torsional loads and "windup" on the main shaft . Their pressing action is smoothly and accurately controlled by ingenious pneumatic clutches and brakes which engage instantly.

The addition of the Warcos nicely rounds out the facilities of Ryan's "press room" which now contains 25 presses ranging in capacity from 30 to more than 1000 tons. These metal crushing giants can perform all four of the major classifications of press function: blanking, forming, drawing and squeezing.

In blanking, the metal is sheared by stressing it to the point of fracture. Heavy pressures are required and the force must be exerted at the point of impact and then quickly released. For blanking large parts, Ryan uses the Warco eccentric gear presses and a 250-ton Bliss crank press. These machines have large beds and long ram strokes. Their maximum forces are exerted one-half inch before the ram reaches bottom center position and are suddenly released an instant later as the ram changes direction.

For blanking smaller components, Ryan schedules production through a bank of 13 Verson, Niagara and Bliss punch presses which have capacities ranging up to 105 tons.

In forming, the metal is bent, with stresses in tension and compression on both sides of its neutral axis, but is not as severely stressed as in drawing. Many types of forming are accomplished on the new Warcos. Parts with intricate detail, such as the C-97 floor beam webs, are usually formed on Ryan's 1000-ton Williams-White hydro press and HPM 250-ton hydro press. These hydraulically-actuated presses have a smooth, accumulative action and rubber pads which are adapted to aluminum alloys. Unlike the eccentric gear and crank presses, their ram movement is determined by presetting the hydraulic pressures to be attained. As the ram descends against the die, the hydraulic pressure rises until it reaches the specified tonnage. At this point, the pressure is automatically released and the ram is raised. Obviously, the hydro presses are not designed for blanking operations.

FOR forming straight angles in sheet metal sections, Ryan utilizes four Sturdybender press brakes. Used also for multi-punching operations, these machines have a capacity of 30 tons.

One of the more severe types of press work is that of drawing, or causing the metal to flow from a flat sheet, or previously drawn shape, over a drawing die.

(Continued on next page)

NEPTUNE ON DRY LAND—Giant Lockheed P2V Neptune, loaned by the Navy to Ryan for research, is pictured with three of its four-man Ryan crew. Left to right, Pete Girard, Curtis "Slim" Franklin and Dick White. Jim Hanson, who will also be in crew, is not shown.

Navy Neptune Joins Ryan Test "Fleet"

Ryan has added another research plane to its in-flight electronics testing projects.

It's a twin-engined Navy Lockheed P2V Neptune, of the type which holds the world's non-stop distance record of more than 11,000 miles, from Sydney, Australia to Columbus, Ohio.

Besides the Neptune, Ryan's "air fleet" in the testing of electronics gear developed here consists of an Air Force North American F-86 Sabrejet, holder of the world's speed record. The Sabrejet arrived at Ryan in November from Wright-Patterson Air Force Base, Dayton, Ohio.

The Neptune, recently overhauled at Alameda, will be flown by Richard E. White, chief project engineer, production; and Pete Girard, aerodynamics and flight test, as first pilots; Jim Hanson, flight test engineer, as second pilot; and Curtis "Slim" Franklin, of the development laboratory, as flight engineer. Hanson also is the F-86 pilot.

A flight program is being worked out to check the accuracy of the electronics gear to be installed in the Neptune.

The PV2 and F-86 have been loaned to Ryan under a policy of the Navy and the Air Force to provide aircraft to commercial firms for special military projects.

Testing of apparatus in the Sabrejet will take place at the Ryan plant and at Edwards Air Force Base, Muroc, while the Neptune is expected to operate solely out of San Diego.

As the metal is drawn over the die, its outer circumference is reduced and the metal crowded together. This crowding ceases as the metal goes over the die radius and into the side-wall of the shell.

The force of the punch produces a radial tensile stress which causes a resultant compressive stress in the flat portion of the sheet. If this compressive stress materially exceeds the tensile stress, wrinkling will result. To prevent this deformation the Warco and hydro presses are equipped with blankholders, or clamping rings, which hold the flat sheet with sufficient pressure to overcome wrinkling but not great enough to cause fractures.

For drawing large skins into smooth, compound contours, Ryan uses a 150-ton Erco stretch press. This machine is misnamed in that it actually places the metal under tension and not compression as other presses do. It is used to stretch-form the large re-fueling pods for the Boeing KC-97E Stratofreighter aerial tanker. Often the dies are heated internally in order to increase the ductility of the metal.

Severest of all press tasks are squeezing operations. These include extrusion, coining, embossing, stamping, swaging, flattening and sizing in order of descending severity. Squeezing involves compression, primarily, although some tensile stress is usually present. Ryan punch presses are kept busy flattening exhaust manifold port flanges after they are welded. Transition liner spacers are coined on the same machines to give them the required chamfer. Exhaust system port tubes are swaged on punch presses to reduce their diameters and outer combustion chambers are embossed in Ryan punch presses. Practically all of the press equipment is used in stamping jobs where the dies are struck solidly against each other.

The development of pressed metal machines and techniques is moving ahead rapidly because of the enthusiasm which production experts are showing for larger, single-piece designs. However, another factor is speeding this development. The scarcity of castings and machine tools for machining them is accelerating the switch to rolled steel weldments. Rolled steel structures have strength characteristics which are more uniform and reliable than castings because the grain structure of the metal is more highly refined. Typical examples of this trend are the huge frames for the Warco presses which are made of welded rolled steel plate instead of castings. These expansive industry trends are pushing the capacities of new presses to unprecedented tonnages to handle such heavy duty assignments.

Naval Engineers View Ryan's Development

Eight naval aviators, all aeronautical engineering officers from the Navy's postgraduate school in Monterey, observed Ryan production and engineering developments during a special field tour recently.

In the group, shown above with Ryan representatives, was Lt. Gordon H. McCormick (extreme right), himself a former Ryan engineer in the early 1940's, during the creation of the famed Fireball fighter. Today he is a career Navy man, as are the others in this group, including Lt. Comdr. L. M. Satterfield, and Lts. John G. Carl, George H. Hughey, Jr., Donald M. Layton, Theodore C. Lonnquest, Jr., Robert A. McClelland, III, and Howard R. Quiel. Other visitors pictured include Lt. Comdr. Alexander Hudjohn and Clifford Rumin of the San Diego Bureau of Aeronautics office.

Ryanites with them in picture are Pat Carter, Dave Williams and Charles Ackerman, of engineering.

CACHE FOR TOOLS

(Continued from page 7)

indoors. And a huge indoor facility—a structure more than 900 feet long—has been obtained by Ryan in suburban Chula Vista, amidst celery fields, for storage of inactive tools.

An indication of the extreme concern for the condition of even obsolescent tools was seen in the Big Floods which hit Southern California last January. Water rose three to four feet in a portion of the Chula Vista warehouse, partially submerging some of the tools. Rather than wait until the flood subsided, Ryan dispatched emergency crews to work day and night to move approximately 1,000 tools to areas in the building not inundated. Other men pumped out the floodwaters, and immediately the job of repairing the water damage to the inactive tools was begun.

When this job was completed, by dismantling every tool, steam cleaning, air drying and re-oiling, the stockpile was in such excellent condition that it could have been drawn upon for instant use in the factory, had the need arisen.

The tool cribs with which most plant workers are acquainted because of their frequent contact with them are those that deal with expendable and perishable supplies.

Expendables are such items as towels, grinding wheels, gloves, aprons, rubber boots, cleaning brushes, welders' helmets, buffing compounds, cleaning fluids, rubber cement, masking tape, hammer handles, etc. In the hardware line, expendables would include set screws, clamps, bushings, washers, dowel pins, nuts, bolts —anything used in the making of tools. These are parts that remain in the larger tools, which are not ordinarily returned to the tool crib, hence are expendable.

The cribs for perishable tools are most likely to feed the machine shop with hardware that may, in the ordinary processes of manufacture, be used up, damaged or worn down. Such would be files, drills, taps, reamers, mill cutters, colletts, chucks, end mills.

When expendable and perishable tools become dulled, but retain a potential continued value, they are sent to the tool repair department, where they are reground or re-shaped. Pneumatic rivet guns are oiled, electrical equipment is repaired and all kinds of apparatus is restored to usefulness in this universal "fixit" shop.

(Continued on page 22)

CACHE FOR TOOLS

(Continued from page 21)

Handling of bulky and heavy tools which must be moved periodically in and out of the main jig and fixture crib necessitates the creation of special facilities. For instance, roller racks were designed by the plant engineering department to enable tool crib clerks to "slide" ponderous dies on and off the racks from fork lift or hand crank lift trucks.

The "cradle-to-grave" progress of a tool is watched closely by the tool cribs, under the over-all direction of C. J. Fitzpatrick, general supervisor of tool control, shop supplies and material planning.

This involves the maintenance of a large inventory of material stores, used in the making of tools—material such as pipes, table tops, tubing, bar stock, etc. Stored in indoor and outdoor areas, these materials comprise a rotating inventory usually valued at more than $160,000. Also under jurisdiction of the tool cribs are the machines used to cut the stock into dimensions required in tool making.

When a tool is required for a certain job, Fitzpatrick's department handles purchase of the materials needed, schedules completion dates to coordinate with production demands, and keeps tab on progress of the work. When the tool is completed and goes into use, it comes under tool crib control, and its life history is recorded much like the service record of a man in the armed forces, with its periods on the "firing line" and periods of "furlough."

Tool cribs and their allied activities are indeed the nerve centers for the actual production work within a plant. At Ryan, this has been big business, particularly within the past year. During 1951, more than two million dollars worth of new tools were either built in the factory or were shipped in to accommodate the rapidly swelling volume of military work on parts for jet and piston engines, and airframe components.

Every one of these tools will have moved in and out of a tool crib perhaps many times in its career. When that career ends, its "service record," whether distinguished or routine, will be fully recorded. And like many an old soldier, its death will not come suddenly. It will fade away gradually in the "pasture" of obsolescent storage.

B-17 Here To Display New Flight Idea

Ryan engineers were among those given an opportunity to examine a special installation in a B-17 Flying Fortress which is touring the country to acquaint various aircraft plants with a revolutionary new idea in operating aircraft, details of which are being withheld. William T. Immenschuh, executive engineer, and Pete Girard, chief dynamicist, tested the principle in flights.

Shown above are Ryanites with flight crew of B-17. Left to right, Immenschuh, Maj. A. Smith, plane commander; D. H. Mendenhall, of Ryan engineering department; Girard, Lt. C. A. Dempsey, co-pilot, H. T. E. Hertzberg, of the biophysics branch, Aero Medical Laboratory, Wright Field, O., and unidentified crew chief. Plane is based at Wright Field Air Development Center.

COPPER SANDWICH

(Continued from page 5)

ruptures in the metal and are greatly aggravated by poor thermal conductivity and high coefficients of expansion.

Cladding is an old art. One of the earliest examples was the creation of Sheffield plate in England when fine silverware was produced by pressing silver and copper together in 1700. A familiar modern use of cladding is the well-known Alclad aircraft sheets which are made by bonding commercially pure aluminum with aluminum alloys. Now, Rosslyn Metal, successfully developed for cooking utensils, may solve some of the critical problems of modern aircraft engine metallurgy.

Jet engine components and exhaust manifolds must operate at extreme temperatures ranging on the high side from 1300° to 1900°F. Combustion chambers, transition liners, tail cones and exhaust systems are fabricated from stainless steels, Inconel and other chrome-nickel alloys which have high corrosion resistance but inherently poor heat conductivity. With copper rated at 100 percent, stainless steel would receive a slim 6.1 percent in thermal conductivity. The effects of hot flame impingement plus poor thermal conductivity, encountered under service conditions, tend to cause warping and buckling of the thin-walled structures and are limiting factors in their design.

In service, temperature variations of as much as 1400°F. have been observed with metals such as Inconel, Inconel X, N-155 and Hastelloy C. Under similar conditions, alloys of higher conductivity have exhibited a differential of only 400° to 450°F. Since temperature gradients are primarily a function of thermal conductivity, Ryan Laboratory engineers are pursuing the Rosslyn Metal experiments with increased interest.

To test the advantages of Rosslyn Metal combustion chambers, Ryan has fabricated them from two types of stainless steel clad RM. These chambers are being service tested and the results will be compared with those obtained from standard chambers of Inconel.

In the piston engine field, Ryan has built exhaust system headers from 19-9DL stainless steel clad RM and these components have been placed on actual airliner test installed on 3500 h.p. Pratt and Whitney R-4360 Wasp Major power plants. Their performance will similarly be compared with the standard 19-9DL exhaust header sections.

Other high temperature elements, such

(Continued on next page)

as afterburner thermocouple vanes, are being built and tested by Ryan. These units employ Rosslyn Metal clad with Inconel.

ROSSLYN Metal can be handled in production in much the same way that the stainless steel or Inconel material alone is processed. It can be formed, welded, machined and spun without difficulty if special attention is paid to its particular characteristics.

Two outstanding benefits may result from the use of Rosslyn Metal in aircraft power plants — savings in weight and savings in critical materials. About five pounds of high temperature alloy are used in a typical combustion chamber and each jet engine employs approximately eight chambers as well as a similar number of transition liners and a large exhaust cone assembly and tail pipe. Substituting Rosslyn Metal for straight chrome-nickel alloys would save 30 percent of the scarce nickel, chromium, columbium and other metals in these components because the composite sheet is 30 percent copper.

An additional saving which Rosslyn Metal offers is a reduction in weight — a particularly interesting benefit to the weight-conscious aircraft industry. This is accomplished by taking advantage of the lateral heat spreading qualities of RM and using lighter gauges than would normally be possible with metals having poorer thermal conductivity. Rosslyn Metal designs would not have to specify extra heavy gauges in order to combat the ravages of "hot spotting." Sheet thicknesses with sufficient strength for the application would be the limiting factor in going to lighter material.

For purposes of approximation, it has been determined that the percentage of reduction in rupture strength at 1500°F. of Rosslyn Metal over solid stainless steel is about half of the percentage of copper in the material. For instance, if the copper percentage is 30 percent, rupture strength reduction at 1500°F. will be about 15 percent.

CONFIRMED laboratory data shows that the strength of RM sheet at temperatures up to 500°F. is at least equivalent to that of a sheet of solid stainless steel having a thickness equal to the RM sheet less two-thirds the thickness of its copper core. For temperatures ranging between 500 and 1500°F., the two-thirds factor becomes one-half, because Rosslyn Metal is relatively stronger at these higher temperatures. Thus, with standard 30 percent copper core RM, 85 percent of the total gauge may be used in design at the rated strength of the cladding at temperatures between 500 and 1500°F.

With these favorable factors, Rosslyn Metal may well become the next metallurigcal step to increased jet engine performance because it could provide for higher operating temperatures as well as longer life. An increase of only 100°F. in the operating temperature of a gas turbine would improve thermal efficiency as much as 30 percent. This is a worthwhile challenge which Ryan metallurgists are putting to service test.

Stainless Steel Welding Methods Observed

Seven key officials of the Pratt & Whitney Aircraft engine plant in East Hartford, Conn., visited Ryan this month to obtain information on the company's advanced stainless steel methods including fusion and resistance welding techniques.

They are shown in photo above, with Ryan representatives, examining jet assembly of Pratt & Whitney engine. Visitors included R. Johnston, production division superintendent; Frank Wallace, welding engineer; L. Dolin, experimental shop; J. Peters, production engineer; R. Taylor, x-ray and inspection department; E. Gagnon, purchasing department quality control group; and A. Eigner, assistant shop superintendent.

Ryanites who escorted them through plant, pictured above, were John van der Linde, production manager; Bob Chase, general foreman, machine shop and jet engine components; Pat Carter, engineering; and Bill Cleator, customer service coordinator.

TANK NO. 61

(Continued from page 11)

Platoon, "D" Company, started northward. On the 15th, "A" Company of the 70th Tank Battalion and "L" Company of the 5th Cavalry Regiment (Inf.) joined "D" Company and formed a small task force.

At 1500 o'clock the steady crunch of the tank treads on the snow was interrupted by the disturbed-wasp-nest sound of angry bullets furrowing the icy air. About 1,000 yards south of Kokusri the small arms and mortar fire became so heavy that the Infantrymen riding on the tanks had to leave them and go afoot. Chinese were well entrenched on both sides of the road. This wasn't the first time the crew of Tank 61 had encountered the Chinese—they had been surrounded themselves at Wonsan back in October and had been without food, water, and ammunition until supplied by air-drop. But Dotson claimed he had never seen as many Chinese as he saw that afternoon.

The chief danger was the numerous rushes the enemy made toward the rear of the tanks with pole and satchel charges. And bazookas at short range were a menace. They accounted for two American tanks that afternoon.

"We hit the Chinese in the back," explained Lt. Giddens, "just as they were about to put the finishing touches on the 23rd. It didn't take the 23rd long to realize that friendly forces were trying to reach them. They wheeled about and started toward our task force—putting the squeeze play on the enemy."

The weather remained cloudy and cold. It snowed all that night. The crew buttoned up the hatches in the tank, ate their rations cold, and catnapped. They took turns at guard, manning the .50 caliber machine gun.

(Continued on page 24)

TANK NO. 61

(Continued from page 23)

Next morning they moved toward the trapped unit with the Infantry riding on the tank decks. As their ammunition was used up the Infantrymen would jump in the ditches with the Chinese—beating them over the head with their entrenching tools.

Assistant Gunner Knutson said he uttered a quick prayer when a round of bazooka ammunition failed to explode and bounced off the turret. "There were so many of them and so much of their equipment all around us, that anywhere I pointed the 90 mm. I could hit something," said Sgt. Kardynal. "We knocked out at least 3 bazooka teams. And did we fire plenty!" added Knutson, "That damn gun smoke got so thick that it started me crying."

Lt. Giddens was lucky. A bullet passed through his helmet but didn't even touch him. But Sgt. Calhoun didn't have the same luck. Some ammunition exploded in the ready rack and he received 1st, 2nd, and 3rd degree burns. He was evacuated with other American wounded. (Incidentally, he recovered and later rejoined his crew.)

Shortly thereafter the task force succeeded in making contact with the 23rd and the French Battalion. In just the small area that "D" Company fought, Knutson counted 1,200 enemy dead. The tankers had accomplished their breakthrough mission.

After any mission, maintenance and resupply is a primary concern. Tankers try to keep their "rolling home and workshop" in tip-top condition so that it can continue performing the job that so many industrial concerns in the United States had created it for. Each man has his maintenance and fighting duties cut out for him.

At Lt. Giddens' suggestion the members of the crew briefly described their duties. "I've got to drive that tank to where the crew can cause the most damage to the enemy," exclaimed Sgt. Calhoun, the driver. "You know, it's a great feeling that by yanking on one of those steering levers I can whip those 47 tons of steel around just as easy as you can drive your car. Of course, I have to be careful of dangerous terrain and mines—I'm supposed to get the tank to the destination safely. Maintenance of the tank, other than the gun, is my job. Included is refueling. Tanks eat up plenty of gas, but refueling is easier than the last war. We use 55 gallon drums now instead of 5 gallon cans."

"Yeah, but those drums get plenty heavy," chipped in Corporal Dotson. "As assistant driver I've got to assist in the maintenance and refueling. In addition, I'm the bog gunner; that's the 30 cal. machine gun down low at the front. That gun must be in operating shape at all times for I have to protect the front of the tank from close-in attack. From time to time I relieve Sgt. Calhoun at the controls. Watching for mines is an important function, but the thing I like best is that in this crew I'm in charge of the rations."

"My job," said Sgt. Kardynal, "is to fire the 90. In order to do this properly the gun must be aligned, sighted, and in perfect working order. I am constantly on the lookout for targets when 'ole No. 61 is in action. As the Lieutenant is in command of the Platoon and has to be away at times, I act as second-in-command of the tank."

"Sometimes they kid me about being 'Marconi' or 'Sparks' because I am the radio operator," explained PFC Knutson, "but as assistant gunner my main job is to load both the 90mm gun and the coaxially mounted 30mm machine gun with the proper ammunition. I also have to eject the empty brass from the tank. It's lucky I have asbestos gloves, that stuff gets HOT. Another job is to store the ammunition and keep an accurate account of ammunition expenditure."

"That's a pretty good account of their jobs," commented their tank commander, Lieutenant Giddens. "As Platoon Leader I coordinate the efforts of the platoon to achieve the maximum effective fire-power. I keep in radio contact with the Company Commander and carry out his instructions. Then as tank commander, I have to fight No. 61. She sure is a honey; we don't want anything to happen to her."

IT'S 340 TIME

(Continued from page 3)

—augmented engine cooling. As the gas rushes into the augmentor tubes it sucks in the surrounding air to aspirate the nacelle. This jet pump action produces a partial vacuum in the engine compartment and causes additional quantities of air to be drawn into the front of the nacelle. It is so effective that sufficient cooling air is obtained for the 340's engines even at idling speeds on the ground.

THIS innovation in engine cooling was introduced by Ryan in the exhaust system for the Ryan FR-1 Fireball, the Navy's first jet fighter and the first jet-plus-propeller airplane to be developed. The Fireball's engine exhaust was ejected within the enclosed engine compartment through slotted openings. The aspirating effect provided added engine cooling and permitted a better enclosure and streamlining of the engine nacelle. First commercial application of this principle was realized in the Ryan exhaust systems for the 240 and 340 Convair-Liners.

More than 140 of the new 340's have been ordered by domestic and foreign airlines. First deliveries will begin this spring. In addition, the U. S. Air Force has ordered an undisclosed number of 340's, designated T-29's, which are to be especially fitted with Allison T-38 turboprop engines. These planes, which will be used for navigator-bombardier training purposes will prove valuable test aircraft to check the advantages of turboprop engines in Convair-Liners—a combination which will interest the nearly 25 airlines flying 300 Convair-Liners by 1953.

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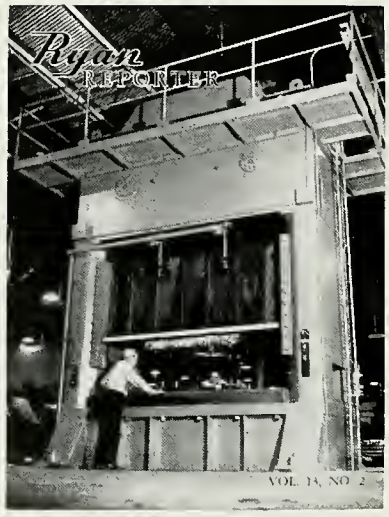
William Wagner, editorial director

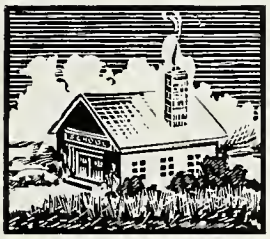


With a 600-ton crush, Ryan's new Warco press stamps out jet engine parts for G-E. Four new Warcos spark trend toward bigger parts.

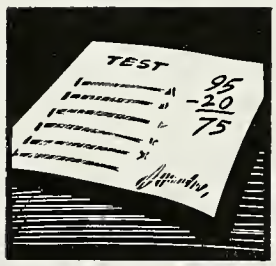
ON THE COVER

HOW I TEACH SOCIALISM

AS A TEACHER in the public schools, I find that the socialist-communist idea of taking "from each according to his ability," and giving "to each according to his need" is now generally accepted without question by most of our pupils. In an effort to explain the fallacy in this theory, I sometimes try this approach with my pupils:



When one of the brighter or harder-working pupils makes a grade of 95 on a test, I suggest that I take away 20 points and give them to a student who has made only 55 points on his test. Thus each would contribute according to his ability and—since both would have a passing mark—each would receive according to his need. After I have juggled the grades of all the other pupils in this fashion, the result is usually a "common ownership" grade of between 75 and 80—the minimum needed for passing, or for survival. Then I speculate with the pupils as to the probable results if I actually used the socialistic theory for grading papers.



First, the highly productive pupils—and they are always a minority in school as well as in life—would soon lose all incentive for producing. Why strive to make a high grade if part of it is taken from you by "authority" and given to someone else?

Second, the less productive pupils—a majority in school as elsewhere—would, for a time, be relieved of the necessity to study or to produce. This socialist-communist system would continue until the high producers had sunk—or had been driven down—to the level of the low producers. At that point, in order for anyone to survive, the "authority" would have no alternative but to begin a system of compulsory labor and punishments against even the low producers. They, of course, would then complain bitterly, but without understanding.

Finally I return the discussion to the ideas of freedom and enterprise—the market economy—where each person has freedom of choice, and is responsible for his own decisions and welfare.

Gratifyingly enough, most of my pupils then understand what I mean when I explain that socialism—even in a democracy—will eventually result in a living-death for all except the "authorities" and a few of their favorite lackeys.

Thomas J. Kelly

Teacher of Economics and History,
Yonkers High School, New York.

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Ryan
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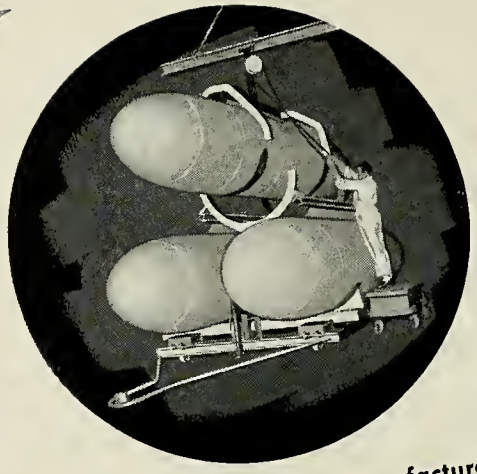


Airframe Components Manufacture
and Navion Executive-Liaison Airplanes

Electronics Research
and Development

Pilotless Aircraft
and Jet Propulsion Research

Ryan activities bracket many fields ranging from development of subminiature electronic equipment to manufacture of huge external fuel tanks and fuselage sections . . . from executive-liaison planes to high-speed pilotless jet aircraft and new applications of jet propulsion.

RYAN AERONAUTICAL COMPANY
LINDBERGH FIELD, SAN DIEGO, CALIFORNIA

Ryan REPORTER

APRIL 1952

VOL. 13, NO. 3

"THE HIGH-TEMPERATURE AGE"

By Charles E. Wilson, former Director of Defense Mobilization

From an address to the Honors Night Dinner audience of the Institute of Aeronautical Sciences given at the Hotel Astor in New York City on January 28, 1952

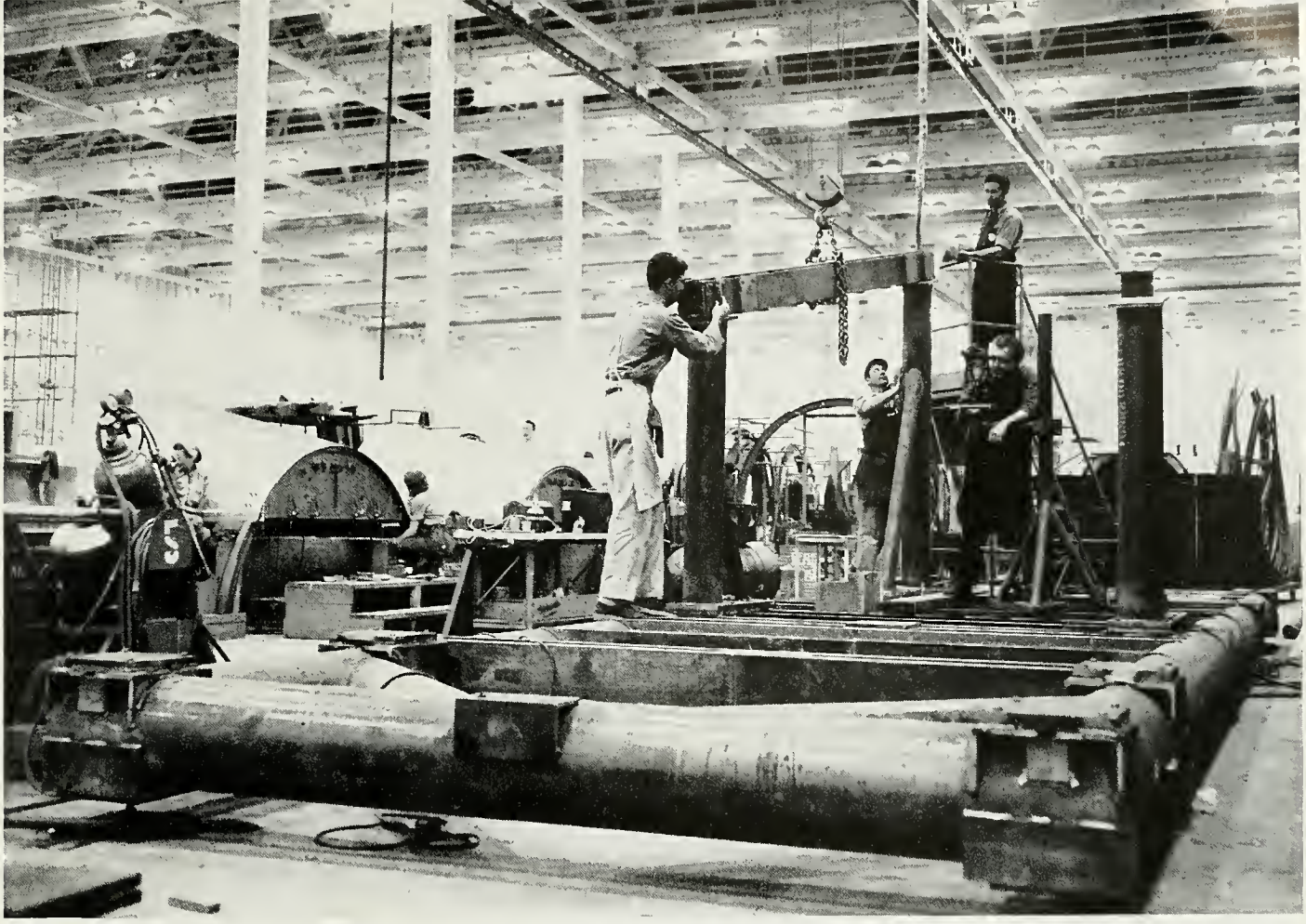
"The jet age might also be called the high-temperature age. This fact profoundly distinguishes the materials and metallurgical problems that exist today as compared with those that existed during World War II. Whereas air superiority in World War II was a function of the perfection of mechanical devices in the form of reciprocating engines, it is now a function of temperatures and pressures that can be withstood by metals.

"In the last war, maximum efficiency in an aircraft was guaranteed when a piston was made to move through a cylinder with a minimum of limitations imposed by fundamental laws of friction, mass, and human perfection in an assembly of thousands of intricate parts. In this age, there are fewer such limitations because thrust in jet engines is largely a function of temperature and is limited therefore, only by the capacity of materials to withstand high temperatures. Hence, major air superiority is a product of the temperatures that the physicists can induce, coupled with the materials that the metallurgist and ceramist can develop to withstand the high temperatures.

Charles E. Wilson

"This condition has forced us to use materials such as columbium, cobalt, tungsten, cerium and others that were largely academic curiosities prior to the recent demands of jet aircraft. Most of these metals are found in useful quantities only in foreign lands; their extraction from ores is immensely complicated by comparison with the well-known metals such as iron and copper; their melting points are so high that they are very difficult to alloy with a base metal such as iron. Along with their high-temperature properties goes brittleness that makes forming difficult—all this plus the fact that high temperature-resisting, hard, brittle materials are inherently difficult to weld. The utilization of these exceptional materials has been a limiting factor in jet engine planning.

"We have also had to look to the day when thrust required to guarantee air superiority will require temperatures that cannot be tolerated by materials exclusively. We are investigating the use of ceramic materials alone or in combination with metals. These materials extend the tolerable temperature range beyond the most temperature-resistant metals. Again, you are faced with immensely difficult industrial procedures unlike anything ever before encountered on our production lines."



Ryan jig-builders are first to translate new orders into reality by assemblying another massive, welded-steel jig for aft fuselages.

RYAN BACKLOG NOW $70 MILLION

$25 Million In New Orders Include Vast Expansion of C-97 Fuselage Production

NEW production orders for more than $25,000,000 worth of its aeronautical products, including the largest single contract of the past seven years, were received early in April by the Ryan Aeronautical Company, T. Claude Ryan, president, has disclosed.

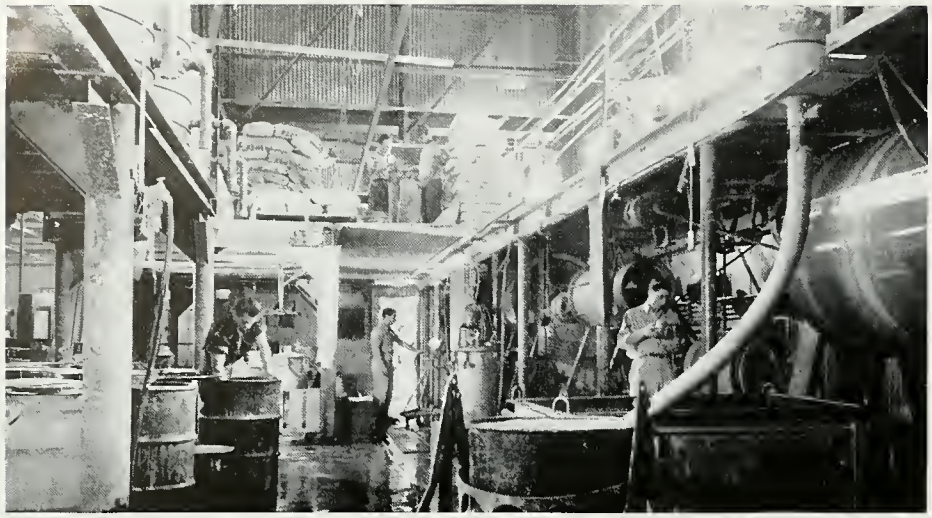
As a result of the added contracts, the company's backlog has been increased more than 56 percent to over $70 million. Orders on hand a year ago amounted to $30 million and two years ago were $6 million. Employment, now 3650 at Ryan's San Diego factory, is planned to rise to approximately 5000 by the year-end.

Largest single order in the new group of contracts is from Boeing Airplane Company of Seattle. It calls for Ryan to substantially increase its output of huge aft fuselage sections, refueling pods, cargo doors and floor beams for the Air Force's versatile Boeing C-97 Stratofreighter, a combination cargo plane and flying tanker.

The Boeing order is the biggest contract Ryan has ever received for airframe components, and was exceeded in size only by the company's wartime orders for Ryan "Fireball" jet fighters for the Navy.

Ryan said the company has been building the Boeing C-97 aft fuselage sections for the past three years and that the new order greatly increases the total number scheduled for production. Last year when the Air Force announced the KC-97 flying tanker model incorporating Boeing's "Flying Boom" for aerial refueling, Ryan began production of the refueling pods which are interchangeable with the Ryan-built cargo doors and are the principal item needed to convert the huge four-engine transports from cargo planes to flying tankers in a few hours.

Other important contracts received, which go to make up the $25,000,000 addition in new orders, include those for Ryan's Metal Products Division from Continental Motors Corp., Douglas Aircraft Company, Pratt & Whitney, Kaiser Manufacturing Company and the U. S. Air Force. These orders are for exhaust systems and other high temperature components for piston and jet engines.



In California Metal Enameling's plant, ingredients for high temperature ceramics are blended with laboratory-like care to attain the unique properties prescribed.

Ryan-Cameo to push development of ceramic coatings for high-temperature aircraft applications

Ceramic Resources

Most modern facility of its type, this 100-foot, continuous furnace at California Metal Enameling is used to fire ceramic coatings at high temperatures. Shown are Ryan jet and piston engine parts traveling on overhead conveyor which circles through furnace.

Pooled

CLIMAXING two years of coordinated production and testing of ceramic coated parts for high-temperature aircraft applications, Ryan Aeronautical Company and California Metal Enameling Company have combined their activities in this field.

Both firms contribute specialized knowledge which will further the development of still better ceramic coatings and speed production of critical parts for jet, piston and rocket engines. The new arrangement combines Ryan leadership in making heat- and corrosion-resistant sheet metal parts with Cameo's half-century ceramics production experience and extensive facilities.

In announcing the merger of their ceramics programs, the two firms also disclosed that an improved ceramic, A-418-Ryanco-C, has been developed as a result of laboratory and service tests, and has been used for some time in production of aircraft engine components.

The "Ryanco-C" ceramic process involves not only improved A-418 ceramic materials but also new methods and thicknesses of application. Extensive gauge studies with the new ceramic discloses that some applications give better results with fairly thick coatings, while others are better when applied extremely thin.

Special significance is attached to the Ryan-Cameo arrangement because of the importance of ceramic coatings to the government's program of conservation of critical materials. The development program the companies have carried out since early 1950 has verified the benefits of special ceramic coatings when used with high temperature components for aircraft power plants. Not only do the ceramic applications extend the service life of alloys specified for jet and internal combustion engine components, but they also make it possible to use lower grade alloys by giving them the rugged stamina required for these applications.

Many vital high temperature components for jet engines, which are now made of Inconel, may be fabricated from type 321 stainless steel and adapted to the same applications with ceramic coatings. Since Inconel contains a minimum of 70 percent nickel and type 321 contains only between 8 and 11 percent of the precious metal, a substantial saving of this scarce material can thus be effected. Similarly, other critically short elements such as columbium, cobalt and tungsten, may be conserved by substituting lower grade alloys, coated with this ceramic, for the richer "luxury class" metals.

The new agreement between Ryan and California Metal Enameling provides that the companies will jointly finance a continuing program of research in the improvement of high temperature ceramic coatings and their methods of application. This work, carried on by the two laboratories, will continue the mutual development program which has been in progress since the beginning of the first experiments two years ago.

The first ceramic material used in this work was A-417 which was developed by the National Bureau of Standards after six years of intensive effort. Although very successful, it was improved by NBS and A-418 was created. From the evaluations made of these ceramics by Ryan-Cameo in the laboratory and in the field, the improved A-418-Ryanco-C has been developed, and a number of innovations perfected in preparing, applying and firing the coatings which gives it maximum toughness and adherence.

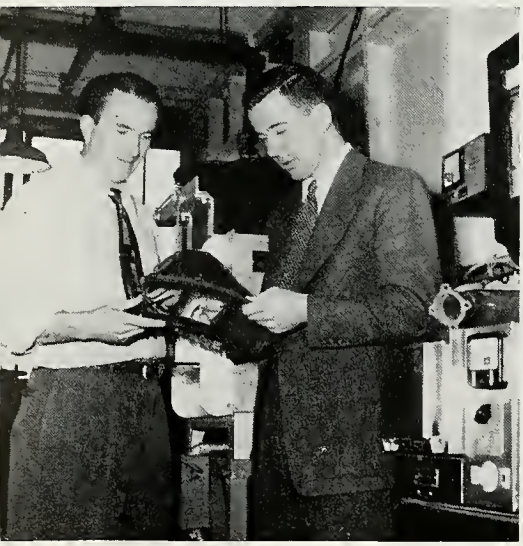
This latest product is designed to perform under continuous temperature of 1800°F. and remains unaffected by thermal shocks encountered in exhaust systems between -70°F. and 1700°F. In addition, the thin ceramic coatings will sustain a surprising amount of mechanical impact without damage.

Founded in 1922, Ryan Aeronautical Company for the past 15 years has held a leading position in the design and production of heat- and corrosion-resistant equipment for the "hot end" of piston aircraft engines. With the advent of jet and rocket engines, and their greater use

(Continued on page 21)

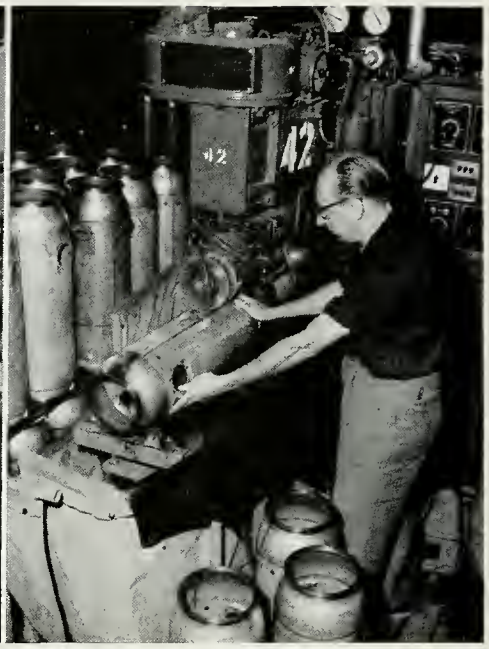
New agreement is signed by Hugh Penton, (right) Cameo officer, and Sam Breder, Ryan executive.

Wilson Hubbell (left) Ryan metallurgist, and Hugh Penton confer on ceramics for jet parts.



California Enameling Company's present plant is fourth factory into which it has expanded since inception in 1911. Plant is conveyorized for full-scale production.

Making four spot welds at a time, this ingenious machine is used by Emilus Morris to stitch inner chambers in true alignment. Conveyor feeds units to seam welder.



G-E outer combustion chambers are seam welded in Ryan line by Michael Johnson.

Torture Cham

Like seething gun barrels, Ryan combustion chambers are precision built to confine jet engine explosions

Rolled from tough sheets of Inconel, Ryan inner combustion chambers are started on their production path by Bruce Boggess.

bers

With a speed which belies their high precision, inner combustion chambers flow down Ryan production lines in a metallic stream. William Tremayne boxes parts right on the line; Ed Flukey checks chambers in precision jig.

Ryan production lines have been streamlined to fabricate thousands of combustion chambers and transition liners for General Electric J-47 jet engines. Hottest operating parts of these turbojets, the Ryan components are precision-made to withstand extreme temperatures and high-velocity gas flow.

Consisting of inner and outer chambers, the combustion chamber assemblies are the torrid heart of the turbojet power plant. Like the cylinders in a piston-type engine, they contain the raging flames which consume hundreds of gallons of fuel per hour. Unlike cylinders, they are made from thin sheet steel instead of heavy cast metal.

At top speed, the J-47 swallows several tons of air a minute. It is compressed and fed to combustion chambers where the fuel is burned. Only a small portion of the air is consumed in combustion. The tremendous heat of the blast expands the balance of the air and causes it to whip through the transition liners and fight its way between the turbine buckets. The caged gases hurl the buckets aside, spinning the turbine and compressor at tremendous speeds. Then, the exhaust spurts from the tailpipe at a 20-mile-a-minute clip. The heat output from this furious furnace is equivalent to that of a steam plant needed to heat a 50-story office building with 4,000 rooms.

Ryan builds J-47 inner combustion chambers from Inconel — a tough, heat-resistant chrome-nickel alloy. The sheets are blanked and pierced in precision dies by huge presses. They are rolled into circular form and welded along their seams with automatic heliarc machines. Powerful punch presses cut out the holes and louvers which permit just the right amount of air to enter and mix with the burning fuel.

The chamber, cap and exit shell are aligned and automatically spot-tacked together in a specially designed welding machine. Seams are closed with fast, seam-welding machines; fittings are spot welded on, and the assembly is ready for a series of minute inspections. When it passes this scrutiny, it is boxed and shipped to the General Electric assembly plant at Lockland, Ohio, where it will receive its baptism of fire.

Control of the engineering requirements of G-E components at Ryan is under the supervision of L. A. Prchal, project engineer. Robert Chase, general foreman, directs the jet assembly lines where combustion chambers and other G-E parts are fabricated.

The function of the inner combustion chamber is to burn as much fuel and air as possible in the briefest time and space. To drive a jet engine compressor requires more than 100 horsepower for each pound of air delivered per second. A pound of air a second provides about 50 pounds of thrust. Therefore, the J-47, which produces about 5200 pounds of thrust, has a turbine which must deliver more than 10,000 horsepower. This

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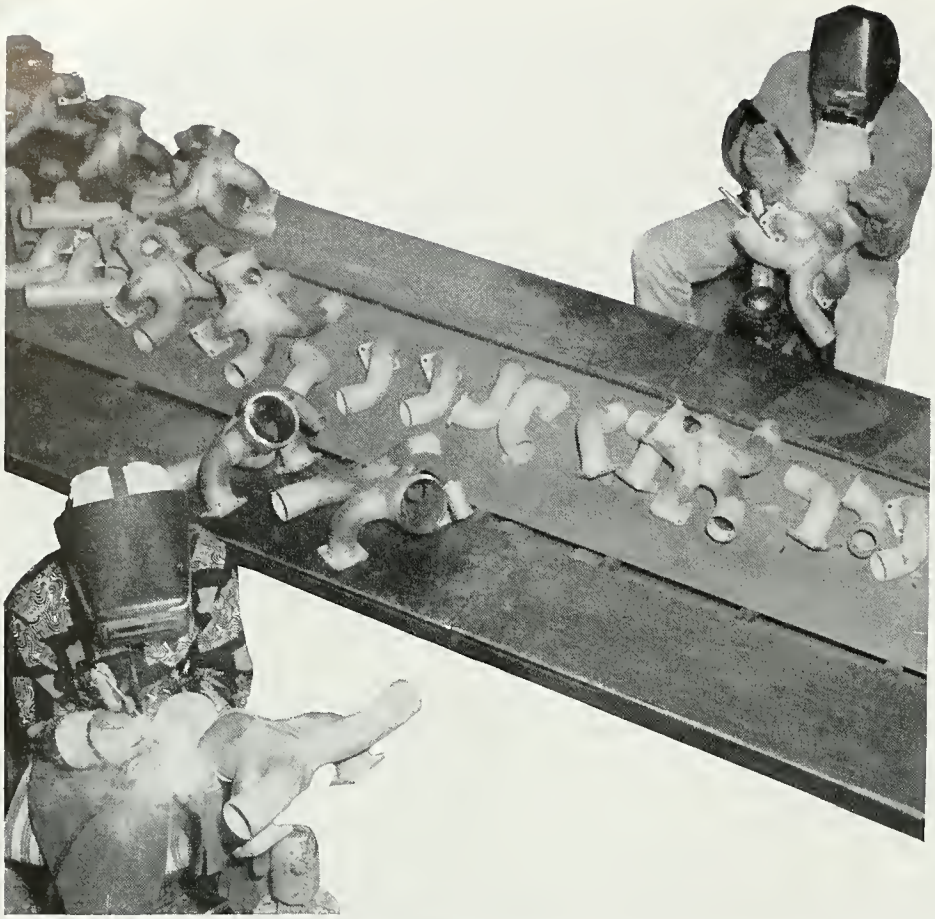


Flanking the motorized belt, Ryan welders Isabel Burke (left) and Harold Faulwetter arc-weld carburetor heat tubes in mid-sections of Continental tank engine manifolds.

SPACE SHRINKER

WITH a new, motorized assembly line technique, unique in the exhaust systems manufacturing industry, Ryan production experts have expanded output and cut factory space requirements in half.

Conceived around a continuous belt conveyor system, the new fabrication line is geared to turn out thousands of exhaust manifolds for the Continental model 1790 engines which power the M-46 and M-47 General Patton tanks. Stretching 140 feet through the heart of the Ryan plant, the motorized belt has neatly solved two problems which perplexed factory supervisors.

Squeezed between expanding production requirements, requested by Continental, and stepped up orders from other important customers, Ryan factory supervisors were forced to dig for ideas. Factory floor space was the problem—it was disappearing in a maze of new machines and assembly lines.

Production and production engineering specialists decided on use of a con-

At belt terminus, Brittie LaPaze (left) attaches bellows; and Russell Stein arc-welds sections into complete unit.

From Ryan, the manifolds go to a Continental Motors line where they are mated with 810 h.p. engine for M-47 tanks.

(c) NGS. Reproduced by special permission from the National Geographic Magazine.

One-way street for parts traffic speeds Continental manifold flow

tinuous belt conveyor system similar to that used in the food packaging industry, with the 1790 program streamlined to fit straight-line assembly methods. This was a distinct departure from standard practice in the industry.

Since its inception, exhaust systems manufacturing has been considered to be more like the garment making industry than any other, because both produce innumerable models and sizes of the product with the same equipment. Consequently, Ryan production machines are arranged along logical parts "flow" lines and the various components are threaded through them in the fabrication process. Machines are placed so that trucks can bring the parts to them and the pathways of the different parts may be widely divergent because of the varying requirements of each model.

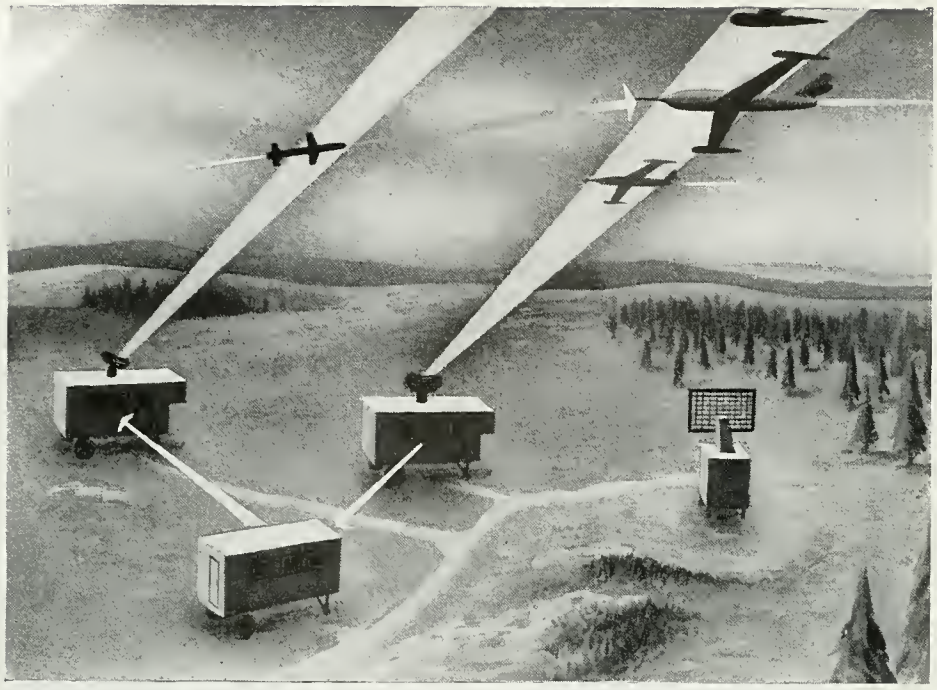
With a straight-line assembly system, a new approach had to be visualized. The machines, tools and jigs had to be carefully positioned along the line. Exact number and spacing of these elements had to be coordinated with the conveyor line speed. Careful timing of each operation was demanded. The 1790 exhaust manifold consists of five separate and differing components: an outlet section, two mid-sections and two end-sections. Each requires different operations performed upon it but all must flow down the same production line at uniform speed.

Eighteen separate tasks, such as assembly, welding, sandblasting, sizing, facing and inspection, must be performed along the line and no back-tracking of the parts is allowed. Smooth dovetailing of these operations had to be planned to insure that the prescribed proportions of each manifold would arrive at the end of the conveyor line. Engineering and tooling changes were worked out to permit the parts to be made under these conditions.

As soon as the new assembly line rolled into action it became apparent that it was the answer. Production of 1790 Continental manifolds has been substantially increased and the space occupied by the entire line is only half of that which would have been required by the former method of fabrication. In addition, the new belt line system has raised

(Continued on page 19)

140 feet long, Ryan's new conveyor belt is a production "pipeline" bringing parts to employees in uniform flow. Design combines accessibility with compact space needs.



COMMAND GUIDANCE SYSTEM: Ground radar tracks missile and target in flight, computes collision course and transmits corrective flight data to missile.

by

Robert McLarren,
Managing Editor, Aero Digest

MISSILE GUIDANCE

Condensed from AERO DIGEST

EVERY major executive in the Department of Defense, be he civilian or military officer, has repeatedly stated publicly that missile guidance and control is the major stumbling block to the immediate achievement of push-button weapons.

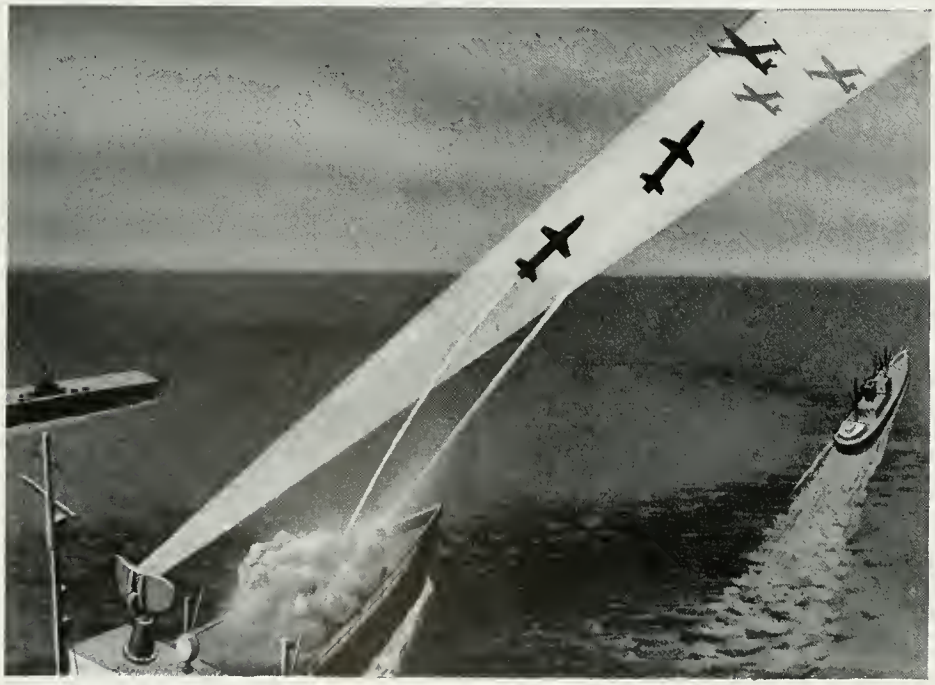
Since V-J Day, there has evolved in the Department of Defense the concept of the "weapons system" as distinct from pure weapons development. The Air Force, Army Ordnance Department and Navy Bureau of Ordnance, acting jointly through the Research and Development Board, are no longer concerned simply with the invention, development and production of new weapons per se but rather with the creation of weapons complexes in which a vast array of elements are teamed together to work as a unit.

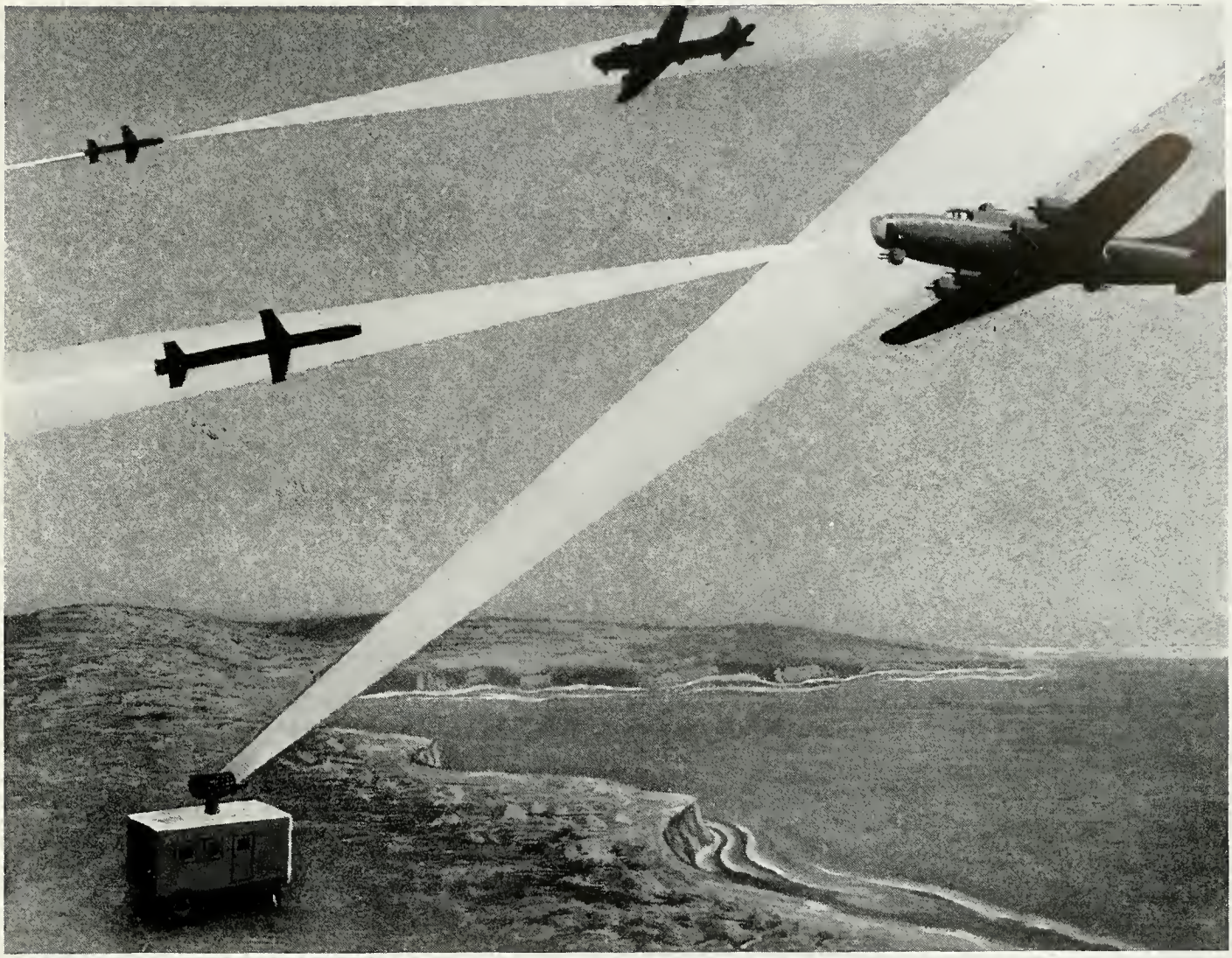
In the classic case of an attacking enemy A-bomber, the separate elements of early warning, interceptor dispatch, bomber tracking, interceptor vectoring, missile launching, anti-aircraft gun laying and firing and ultimate bomber destruction are integrated into a single weapons system all automatically controlled.

That the early-warning radar may be located on a picket ship operated by the Navy, the interceptor belong to the Air Force and the anti-aircraft guns owned by the Army, is the essential necessity for an integrated armed force.

Within these weapons systems lies a seemingly endless range of jobs for the missile and the foreseeable goal is the availability of a missile for every combat job, bar none. Thus the missile is being called upon to absorb the limitless array

BEAM RIDER GUIDANCE SYSTEM: Missile is directed by following a radar beam from the surface which is aimed at target and measures missile course deviation.





HOMING GUIDANCE SYSTEM: **Top illustration shows missile "homing" on target by following its own illuminating beam. Below, missile is "homing" on ground beam reflected from target. Another system operates by missile "homing" on target radiation.**

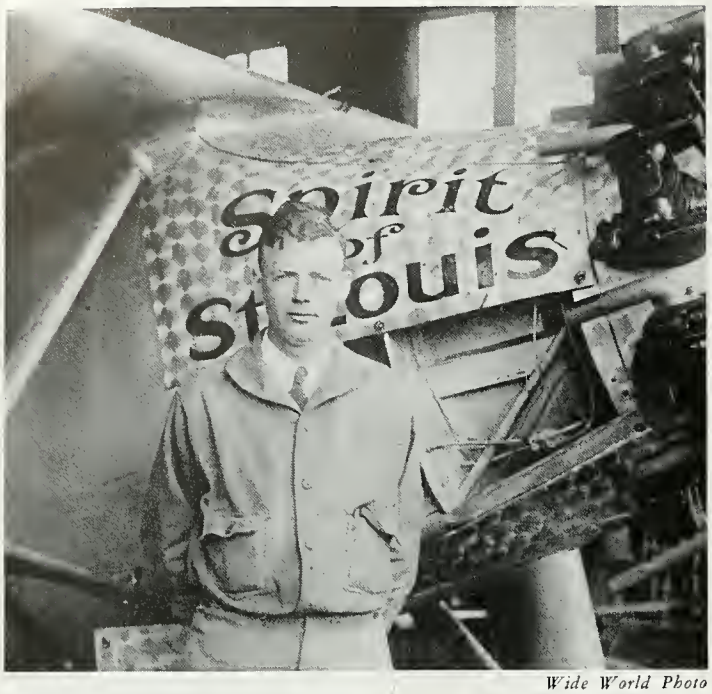
of combat articles previously requiring the services of the fighter and the bomber, the battleship and the submarine, the infantry soldier and the artillery. While the list of such jobs would require hundreds of pages, logical definition of the types of jobs to be done in battle has reduced this list to only eight functions, as shown in the table on Page 24. But within each of these functions lies a panoply of missiles ranging the gamut of human technical ingenuity in their type of propulsion, basic function, size, performance and general arrangement.

The process of evaluation alone taxes the human capacity and yet even these fantastic figures are multiplied into the hundreds of thousands when the more detailed aerodynamic and electronic problems of guidance are explored.

It is for this reason that the missile is

(Continued on page 24)

RYAN XAAM-A-1 "FIREBIRD": **Air Force's first air-to-air guided missile, the Ryan "Firebird" was "intelligent" target-seeker after launching by "mother" plane.**



Wide World Photo

The "Lone Eagle" arrives in New York, unheralded and unknown, to complete preparations for transatlantic hop in Ryan plane.

THE FATEFUL 60 DAYS

Ryan crew worked day and night to complete "Spirit of St. Louis" on time

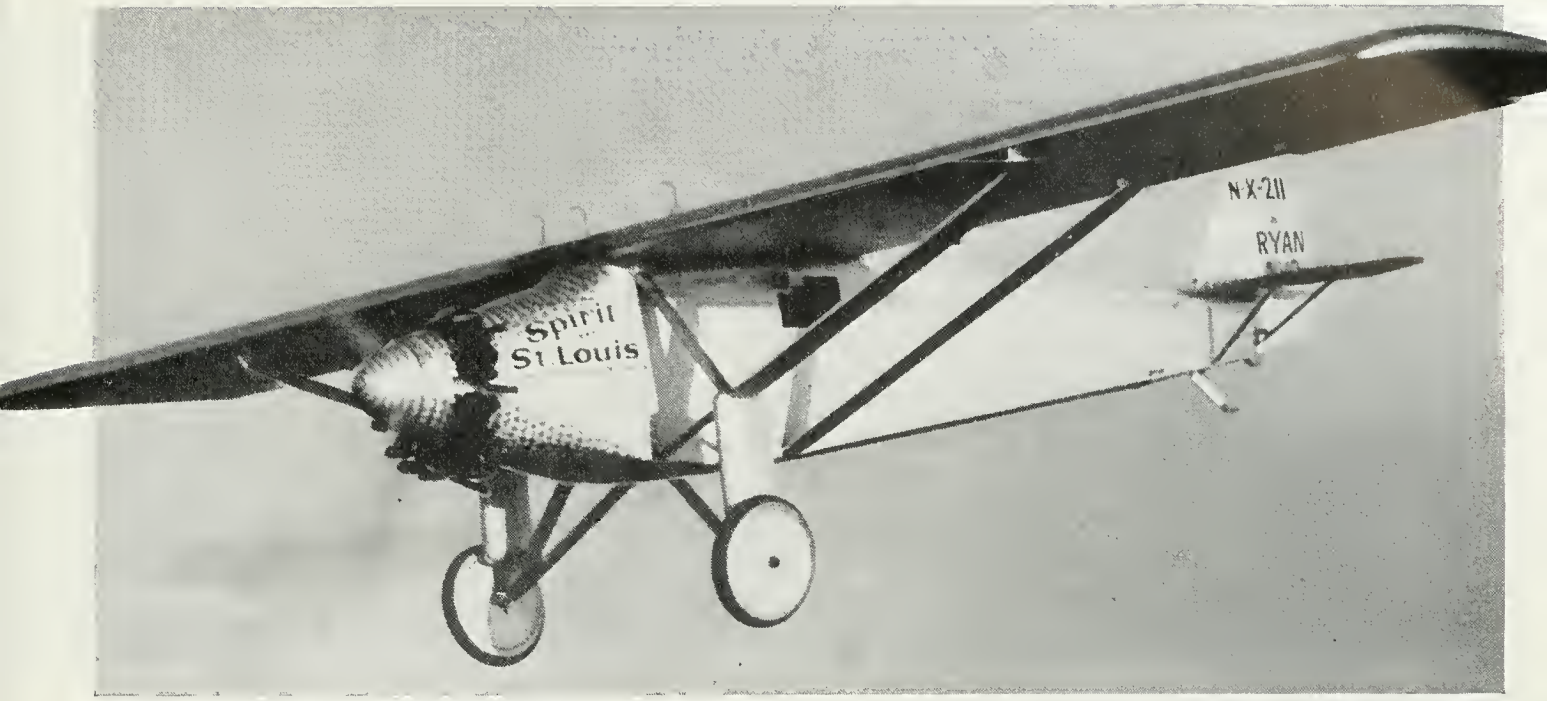
THE flight which launched the modern Air Age, Charles A. Lindbergh's solo spanning of the Atlantic exactly 25 years ago May 20, was preceded by a fateful, feverish 60 days in San Diego.

This was the period of construction of the "Spirit of St. Louis," a rush job for an unknown air mail pilot from St. Louis who came to the Ryan Airlines company because he knew of the serviceable characteristics of its famed M-1, the first production model monoplane in the United States.

Lindbergh also had heard about the newer Ryan Brougham, a five-place plane which was being built for Frank Hawks. With some modifications, this would, he believed, meet his requirements.

Today, besides T. Claude Ryan, president of the Ryan Aeronautical Company and founder of the old Ryan Airlines concern, four men who helped build the "Spirit of St. Louis" are still employed at Ryan. They are John van der Linde,

This historic photo shows "Spirit of St. Louis" at Ryon airfield, San Diego, just before first test flight by Charles Lindbergh.



World's most famous plane lacked straight-ahead visibility, but made up for it through better streamlining and safety for pilot.

now production manager; Walter O. Locke, assistant to the president; J. J. "Red" Harrigan, tank assembly inspector; and Fred Magula, assistant foreman, Boeing jig assembly.

Van der Linde was chief mechanic in those days, when the entire production crew comprised some 25 men. The work schedule on the "Spirit of St. Louis" consisted of seven days a week, 6 a.m. to 1 or 2 the following morning.

Improvisation was the byword. Drawings didn't mean much. Magula remembers that all his sheet metal work was handformed over sandbags. Jigs were unknown.

Van der Linde's most embarrassing moment occurred the time he lost a rubber tube inside the "Spirit of St. Louis'" main gas tank. The tube, inserted in the filler neck to let the tank "breathe" while it was being filled, slipped all the way in during a fueling.

"We had to drain the tank and work all night getting that blasted tube out of there," he recalls. "We cut a hole in the tank and then fished it out with wires. We patched the holes with solder and screws."

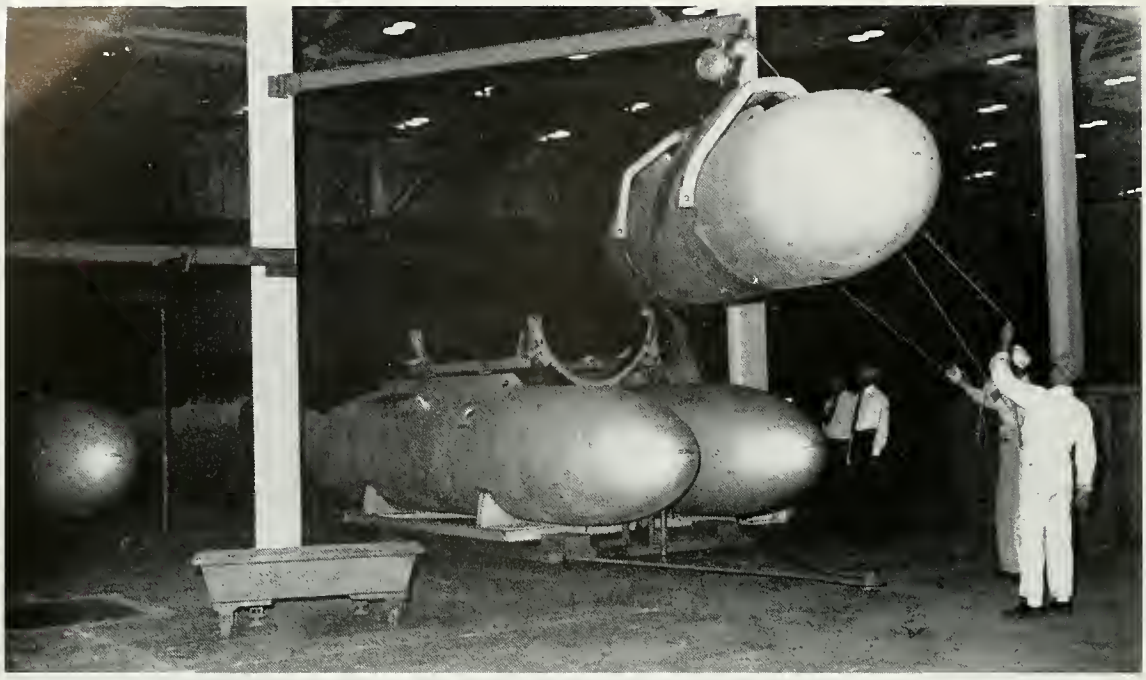
The "Spirit of St. Louis" came close to being a wreck and Lindbergh a dead or seriously injured unknown before the immortal flight.

When his plane was completed, Lindbergh insisted on making the first flight and all additional check hops himself. Full-load takeoff tests were run at an

(Continued on page 25)

Lindbergh chose Ryan monoplane because of reputation of M-1 and M-2 in airline use. Note striking resemblance of Bluebird, M-2 cabin version, to "Spirit of St. Louis."

Still with Ryan, 25 years after they helped build "Spirit of St. Louis," are, left to right, J. J. Harrigan, Fred Magula, John van der Linde, and Walter O. Locke.



Giant external wing fuel tank is lowered into top of three rubber-lined cradles of special shipping rack.

Tanks are towed to dock

SPECIAL DE

Freight car which is ex

Six giant fuel tanks can be carried across country for every two once delivered

Old-fashioned shipping method leaves much waste space.

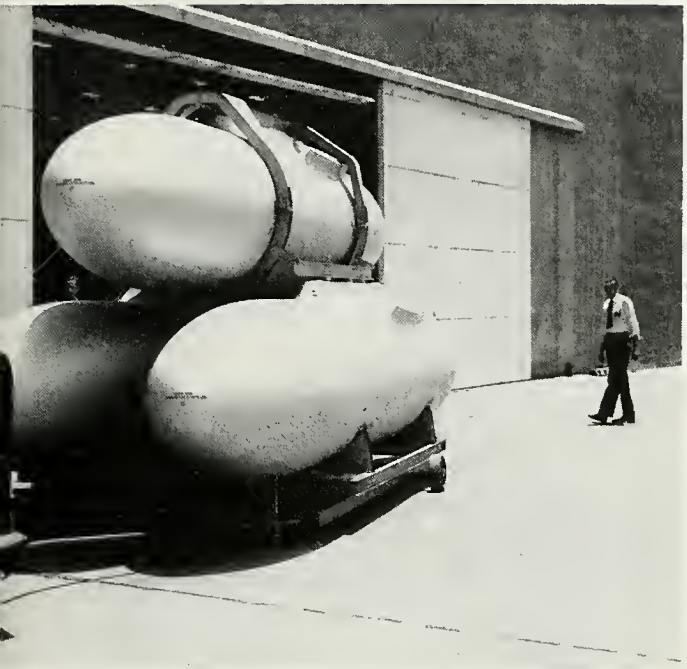
THE largest external wing fuel tanks ever built for aircraft are being delivered from the Ryan Aeronautical Company's San Diego plant in a steady, ever-increasing flow — thanks in part to a unique, specially designed transportation system.

Today, six tanks can be shipped simultaneously, where only two were sent before. The material handling system involves monorails, jib cranes, shipping racks, transport dollies, tracks, a special loading dock and unusually large freight cars.

Ryan and the eastern factories to which the tanks are shipped were confronted with the uncertainty of shipping facilities in the face of a mounting production volume.

Shipping two crated tanks to an ordinary automobile box car was unsatisfactory, not only because of failure to utilize the space fully, but because of the uncertain supply of this type of railroad equipment. A second major advantage of the

(Continued on page 21)

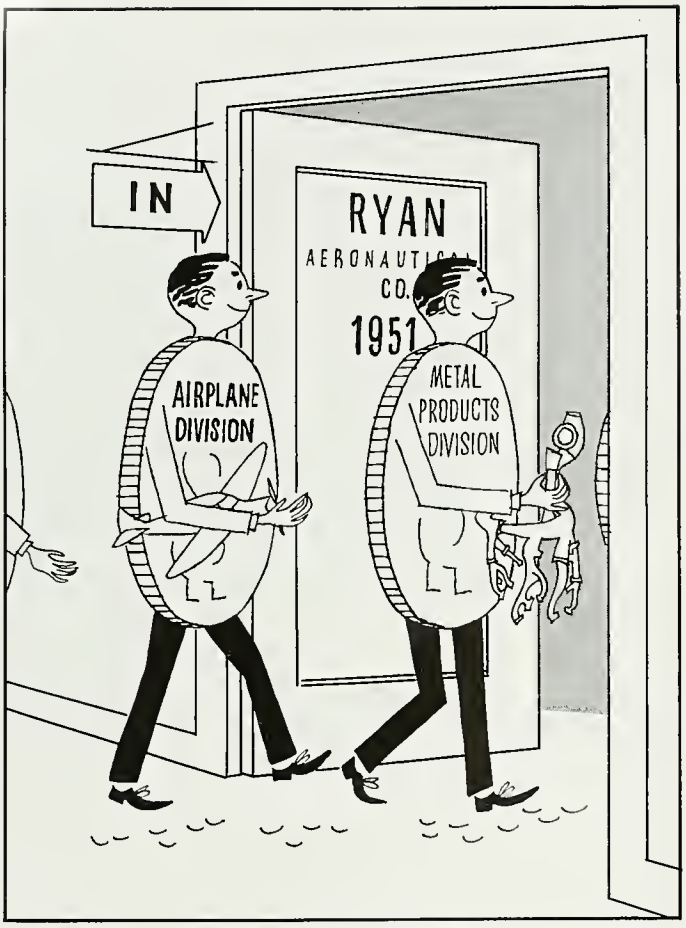


yan railroad siding on transporting dolly hitched to truck.

LIVERY

Shipping rack is pulled up ramp by cable operated by geared winch.

ong, extra high and extra wide is ready to receive shipping rack with three tanks. Each car can accommodate six tanks in two racks.



$22,277,175 was rung up on Ryan's cash register last year — $10,883,795 by the Airplane Division and $11,393,380 by the Metal Products Division.

$8,976,827 WENT OUT FOR MATERIALS, SUPPLIES AND SERVICES

In 1951, vast quantities of raw materials and supplies had to be bought, freight bills paid and many other expenses met to run this business.

1951 was a busy year at Ryan

(Condensed from Ryan's Annual Report for 1951)

Ryan Aeronautical Company's gross revenue of $22,277,175 for the twelve months ended October 31, 1951, was the highest in six years and was exceeded only by the peak World War II delivery rates of 1943, 1944 and 1945.

The 1951 sales volume, which was approximately $10 million greater than for the previous year, resulted in a profit of $827,604 *before provision for federal taxes* on income. Net profit remaining *after deducting federal income taxes of $425,000* was $402,604, or approximately $1.02 profit per share. This compares with a net profit of $1.61 per share on a $12,512,851 sales volume in 1950.

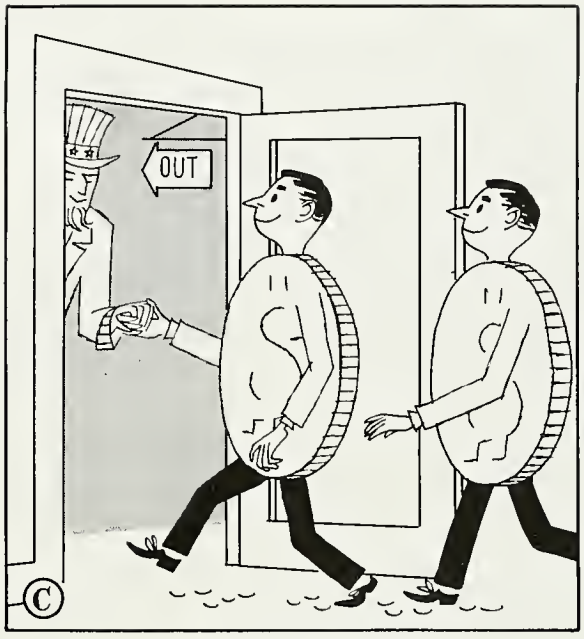
It is interesting to note that 51% of the $827,604 earned by the company was paid out in income taxes for support of activities of the federal government.

The savings of ordinary citizens, who have accumulated money through years of hard work to invest in American industry, are today working for the government to the extent of more than half their earning power. The owners of shares in American industry are doubly taxed; for in addition to the federal taxes on income of the corpo-

(Continued on page 23)

$334,792 WENT OUT FOR DEPRECIATION

This fund was provided for replacement of worn out or obsolete machines, tools and other facilities of production.



$1,108,671 WENT OUT IN TAXES

In the role of tax collector, Ryan last year relayed over a million dollars to Federal, State and local governments.

Next Page Please

HOW THE DOLLARS COME AND GO!

OUR CUSTOMERS PAID US		Total	Percent
For products of our Airplane Division		$10,883,795	48.9%
For items of Metal Products Division		11,393,380	51.1%
TOTAL INCOME		$22,277,175	100.0%
In making these products, Ryan paid these bills:			
A. Cost of MATERIALS AND SERVICES bought from other		$ 8,976,827	40.3%
B. Cost of PAYMENTS ORDERED BY GOVERNMENT		1,108,671	5.0%
C. Cost of TOOLS (and facilities) WEARING OUT		334,792	1.5%
D. Cost of HUMAN ENERGY paid in WAGES AND SALARIES		11,454,281	51.4%
E. Cost of USING TOOLS OF PRODUCTION (Profit)			
"Take-Home Pay" of 1100 Owners	$196,921 (0.9%)		
Re-invested in the Business	$205,683 (0.9%)	402,604	1.8%
TOTAL COSTS		$22,277,175	100.0%

After the payments shown in the previous sketches, there was a balance of $11,856,885 available for a three-way split between Ryan's

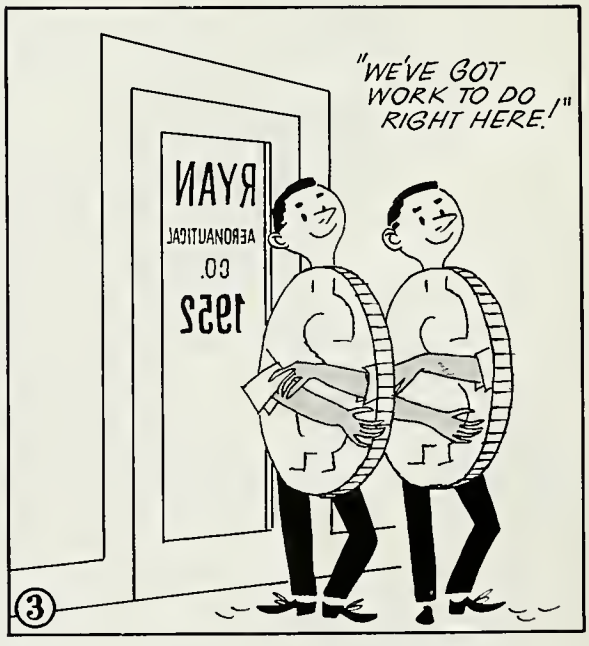
1. **Employees**
2. **Stockholders**
3. **Reinvestment in the Business**

96.6% of the balance available
WENT TO RYAN WORKERS

The bill for wages, salaries and many employee benefits came to $11,454,281 for the year.

1.7% of the balance available
WENT TO STOCKHOLDERS

In return for the use of their savings which are invested in the Ryan company, the 1100 owners received $196,921 in cash dividends during the year.



1.7% of the balance available
WENT BACK INTO THE BUSINESS

Out of the $11,856,885 available for employees, stockholders and reinvestment, $205,683 has gone back into the business for future development and expansion.

Urgency of stainless steel shipment was dramatized in night-time unloading of more than 12 tons at Ryan plant during heavy rain.

STEEL TO THE RESCUE

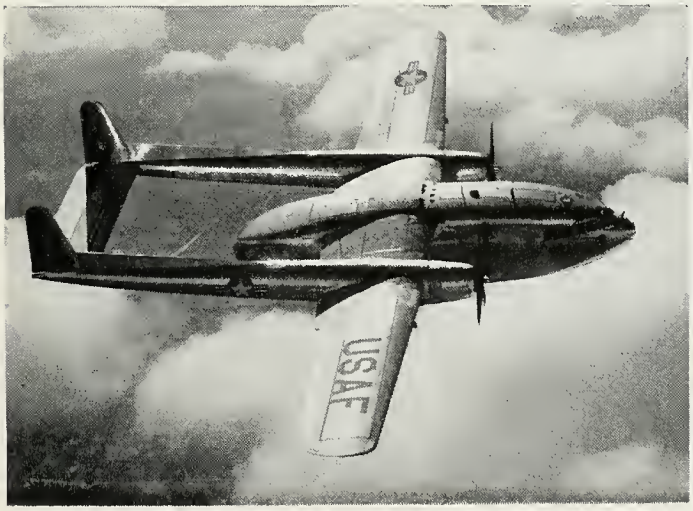
MORE than twelve tons of sheet steel needed to speed manufacture of exhaust systems were recently air-lifted from Pittsburgh to the Ryan plant at San Diego. To meet the schedule for the high-priority exhaust equipment for Fairchild planes, Ryan officials had to slash red tape right and left.

With the largest air shipment of steel aboard, two Air Force Fairchild C119-B "Flying Boxcars" flew in from the east with the material needed for emergency production of exhaust manifolds for the Pratt & Whitney engines which power the C-119B's.

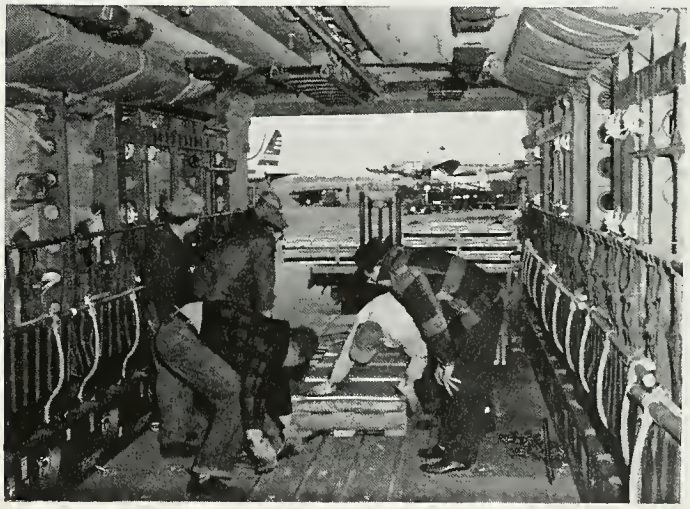
The story begins in Korea, where the Air Force ran out of spare manifolds to keep the big transports in the air on their cargo, personnel and ambulance carrying missions. When the Air Force obtained the needed manifolds directly from the Fairchild factory at Hagerstown, Md., they left the shelves virtually bare and

(Continued on page 20)

Two of these Fairchild C-119B "Flying Boxcars" delivered emergency supply of steel from Pittsburgh to San Diego.



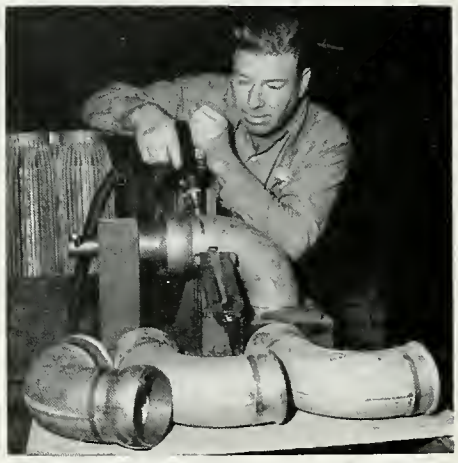
Red tape was slashed and precious 19-9DL cargo was loaded in C-119B to expedite production of Ryan exhaust systems.



A modern "Trojan warhorse," the new T18E1 personnel carrier convoys twelve infantrymen through enemy fire with steel-clad safety.

Team-Mate For A Tank

Army's new "squad car" is rolling pillbox



Jess Whitney spot-tacks Ryan ball-and-socket assemblies for T18E1. These are flexible, steel tubes which pipe fiery exhaust gases from Continental engine.

Big rear doors, overhead machine guns and full tracks are salient features of T18E1.

ANOTHER combat vehicle has been added to the procession of planes, tanks, blimps and helicopters which are using Ryan exhaust equipment. It is the armored personnel carrier which is being manufactured by Food Machinery and Chemical Corporation for the Army Ordnance Corps.

Designated the T18E1, the new vehicle is a full-tracked carrier which can transport twelve equipped infantrymen into the thick of battle with steel-clad protection against gun fire and shell fragments. With a sustained speed of 35 miles an hour and tank-like facility for rolling over 60-percent slopes, the unique carrier is made to order for bringing in-

(Continued on page 22)

SPACE SHRINKER

(Continued from page 7)

efficiency by reducing employee fatigue, preventing parts damage, simplifying training and providing better control of parts.

Key function of the motorized belt is to bring the parts within easy reach of every employee in a uniform flow. This relieves him from having to move about to get and dispatch parts, load conveyor trucks and wait for others to bring components to him. This saves his time and

Production experts (l. to r.) Ray Ortiz, Robert Clark and Floyd Bennett confer on new belt line layout and techniques.

energy. It also permits the telescoping of all machines into minimum space because room for truck delivery is no longer required.

PARTS are maintained in top condition as they are fabricated because they are transported upon a rubber-impregnated belt. Time required to orient experienced employees to the assembly pattern is stepped up from two hours to only thirty minutes because the complete sequence of operations is laid out along a straight line which can be quickly understood by a newcomer. Certain employees are trained for all tasks so that they can be substituted in place of those who may miss work because of illness.

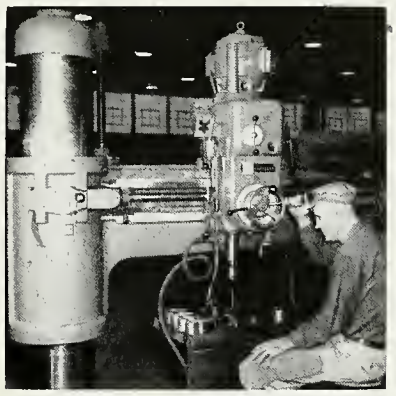
Control of the parts and fabrication rates is simplified because the foreman can see at a glance where all components are and determine causes for shortages or delays without looking in several areas.

An added premium resulting from the installation of the new system is the approval of the employees who work on the line. Generally, they like the new method and welcome the benefits which it brings to them in facilitating their work.

The conveyor system was built and installed by the Standard Engineering Company of Los Angeles, California. The belt is a continuous loop, 280 feet long and 22 inches wide, made of rubber-impregnated canvas. It is suspended over steel rollers along the 140-foot assembly line and wound around steel, rubber-coated drums at each extremity. Power is supplied by an electric vari-drive motor which can be adjusted to provide belt speeds running from a few inches to several feet per minute. A magnetic push-button starter actuates the system.

Ryan specified the addition of a steel shelf which is located on each side of the belt so that parts can be removed from the conveyor without creating a storage problem at any station. The width of the belt and shelves is designed to give complete access to parts from both sides of the belt line.

These design specifications and the good flexibility of the conveyor drive give the system wide usefulness and adaptability to other types of fabrication.



FIRST FOREIGN-MADE TOOL GOES INTO OPERATION

The inscription on the side reads: "Ateliers Guillemin Sergot Pegard, 16 Boulevard Flandrin, Paris."

This unusual designation proclaims the origin of the first foreign-made machine tool to be installed in the Ryan plant, a French radial drill whose manufacturers ("ateliers") are Guillemin Sergot Pegard in Paris.

Just placed into operation in the new jet engine parts building, it is the first of three similar drills acquired by Ryan late last year when the machine tool situation in this country was extremely tight. The other two have recently been delivered and have not yet been installed.

Controls differ somewhat from U. S. radial drills, but the French machines are sturdily built and their output is of high quality, according to the men who have been operating it, including M. M. Ramey and Jack Stanley.

TORTURE CHAMBERS

(Continued from page 5)

mighty force is unleashed within the inner combustion chambers.

The inner combustion chambers are inserted into outer combustion chambers which are hermetically sealed tubes of stainless steel. Ryan builds these structures in similar fashion to the methods used for inner chambers. A water-alcohol mixture is injected into the combustion area to provide boosts in thrust output for limited intervals which increases the mass flow and the exhaust velocity.

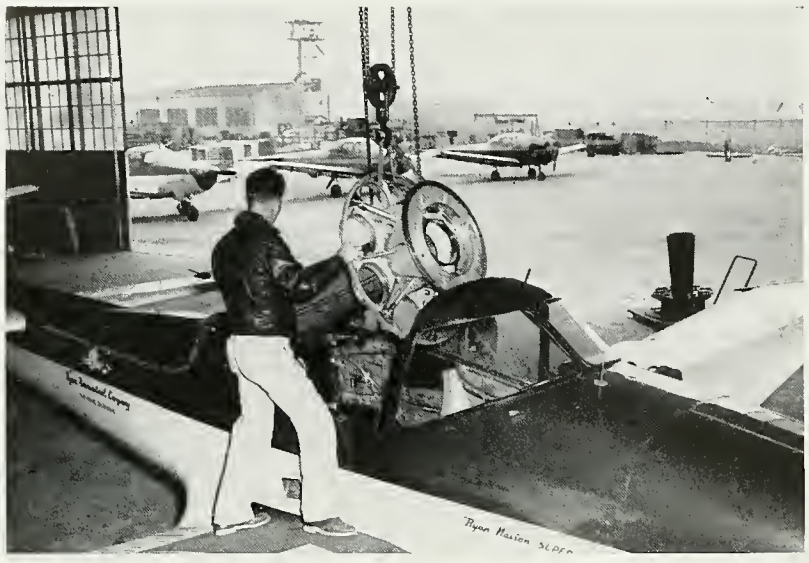
The function of the outer combustion chamber is to direct tremendous quantities of compressed air into the inner chamber, for combustion and expansion, and to act as a cooling shroud for the inner chamber. This cooling effect is attained by a sheet of air which flows between the inner and outer chambers, carrying heat away from the raging fires. The combustion unit is designed to start the burning of the fuel at the front end of the inner chamber and to complete this combustion before the gases reach the rear.

If the flame front follows the hot exhaust from the chamber or bursts out through the holes and louvers, a "hot spot" will develop. This phenomenon results in the flames surrounding both surfaces of the inner combustion chamber and prevents the cooling air from coming in contact with the metal. The sudden temperature rise then consumes the metal in this area. It is a testimonial to General Electric designers that huge quantities of fuel are successfully burned in the restricted space allocated in the inner combustion chambers without metal attrition.

Because the inner and outer combustion chambers must fit together in perfect alignment, close control of the dimensions of these components is a vital requirement of their fabrication. When the inner chamber is inserted into the outer shell, the maximum allowable clearance between the two, at the flange ring, is a miniscule fraction of an inch. Rigid demands for concentricity and roundness must be met. First, the faces of the front and rear flanges of the outer chamber must be flat and parallel within minute tolerances. Then, while meeting these requirements, the flanges must be concentric with the inner chamber. These are extremely high tolerances to meet in welded sheet metal structures.

Wide variations must be accommodated due to extremely high operating temperatures of the inner combustion chambers. Provision for thermal expansion of the inner chambers is made by suspending them from the fuel nozzle entry

(Continued on page 20)



Ryan "Airlift" Does Emergency Jobs

Ryan's own "airlift" has been performing varied emergency jobs in recent weeks, as the company's two Navion Super 260s shuttled between San Diego and points north and east.

Walter K. Balch, head of airplane service, made a hurry-up trip to Inyokern to rush sample pieces of the aft frame of a new series General Electric jet engine to the naval base for heat treat tests. This was necessary before the first aft frame itself, being shipped by truck, could be treated in the furnace, which is being relied upon pending completion this month of the installation of giant G-E heat treat facilities in the new jet engine parts building.

Balch was accompanied on this flight by R. E. Grabowsky, executive assistant to the factory services manager, and John Lepman, of outside production.

Between Navion flights to Holloman Air Force Base where Ryan XQ-2 target plane tests are being made, several emergency trips were made to Los Angeles to haul rocket motor parts for furnace brazing by a subcontractor to meet deadlines on deliveries to Firestone.

Also flown to Los Angeles were external wing fuel tank rings for machining when one source fell behind in this work; and various parts to California Metal Enameling Company for ceramic coating on rush orders.

Once weekly, William P. Sloan, outside production supervisor, pilots a Navion to Los Angeles to meet vendors in Ryan's Los Angeles office regarding production problems. Other company personnel with business in the Los Angeles area are taken at the same time.

TORTURE CHAMBERS

(Continued from page 19)

and allowing them to join the transition liners, at the rear, by means of a "slip fit" connection. This arrangement gives them a "floating" suspension inside of the outer chambers and permits them to increase in length and diameter without resistance. Outer combustion chambers are fitted with a stainless steel bellows at the rear end, which provides them with a flexible joint for thermal expansion and to facilitate assembly.

Two of the inner chambers in each J-47 jet engine are equipped with spark plugs for initial ignition. Through a series of interconnecting tubes, called "cross-over" tubes, the adjoining chambers are quickly ignited, much like the pilot light ignites burners on a gas range. The cross-over tube ports also carry a high precision requirement which specifies that they must be positioned within a fraction of true location in all chambers.

The dramatic functions of the combustion chambers have overshadowed the less-known transition liners and little popular attention has been accorded them. These parts are irregularly-shaped ducts which receive the searing exhaust from the inner chambers and direct it to the nozzles and buckets of the turbine section. Their front cross-sectional opening is circular to mate with the inner combustion chambers. At the rear, they are more or less rectangular-shaped in cross-section to steer the fast-flowing gases into a turbine wheel arc.

Ryan builds these components from Inconel. In many ways they are the most critical sheet metal part of the modern turbojet—even more marginal than the combustion chambers. In addition to the withering temperatures of the blasting gases, they are submitted to pressure pulsations in the gas stream flowing through them. This requires that they be fabricated with highest quality control as well as precision. Even small scratches or blemishes, which would be harmless in other components, could well develop into stress fractures under the severe temperature and pulsating pressures peculiar to transition liner service life.

The advent of the jet engine has greatly emphasized the importance of precision sheet metal and machined member fabrication for high temperature applications, such as Ryan has specialized in for many years. This is because the turbojet employs so much more of this type of structure than its conventional piston engine predecessor.

The ever-growing dependability of the turbo-jet is attesting to the success with which manufacturers, such as Ryan, are meeting the new, higher specifications for this modern power plant. For combat duty, the jet engine is proving remarkably reliable and rugged. For instance, a Korean report tells of one case where a 50 caliber bullet went through a combustion chamber without disturbing engine operation and was not discovered until inspection. Now, almost universally accepted for military aircraft, the turbojet is headed for a big future in commercial operations.

STEEL TO THE RESCUE

(Continued from page 17)

the transport assembly line there was threatened with shutdown for lack of these engine components.

The only solution was a rush order to Ryan for delivery of more than 100 engine sets sooner than originally scheduled. The major bottleneck was materials, particularly steel.

Ralph E. Flanders, Ryan material control supervisor, went to Wright Field and to Washington, D. C. to obtain authorization for steel in less than the normal procurement time. Paper work that would ordinarily have required 30 to 45 days was reduced to two days, and Universal Cyclops Steel Corp., Bridgeville, Pa., produced the steel which was flown to San Diego by Air Force crews.

The material was unloaded at the plant at the height of the weekend rainstorm March 15-16. No time was wasted in the race to fill the order which would keep Fairchild's assembly lines moving.

SPECIAL DELIVERY

(Continued from page 13)

new method is the earmarking of eleven specially built box cars for the purpose of shipping these tanks and no other item. The eleven cars, built extra long, extra high and extra wide for World War II shipment of aircraft parts, were set aside by the Santa Fe Railway exclusively for this project. At the same time, an array of special equipment for handling and loading the tanks was provided.

Twenty-two shipping racks — two to a car — were built. Each consists of three rubber-lined cradles to support the tanks in triangular formation, two tanks side by side below and a third at the apex between and above them. Rails on which the racks can move were installed inside each of the eleven cars.

At Ryan, a special concrete ramp and loading dock, 125 feet long and 12 feet wide, with a 28-foot "L" parallel with the Ryan railroad siding was constructed. On this dock, rails were laid to control the movement of the racks up the ramp to the main dock.

A large transport dolly was built by Ryan to carry the racks from paint shop to shipping dock across black-top asphalt areas that might otherwise be damaged by their grooved, swiveling casters.

Overhead monorails were installed in the paint shop and an adjoining area where the tanks are kept 24 hours while drying.

From the monorails, the tanks begin their journey. A jib crane lowers each tank to a weighing dolly placed on a scale at the end of the monorail line. After the exact weight is stenciled on the top fairing of the tank, the same jib crane transfers it from the weighing dolly to one of the cradles in a specially-built shipping rack.

The transporting dolly is a low underslung carriage with adjustable ramp rails extending to the rear. Up this adjustable ramp the loaded shipping rack, weighing approximately 3300 pounds, is pulled on to the carriage by means of a cable and winch. After the load is in position, the ramp rails are leveled for transporting.

A Mercury Banty truck is hitched to the transporting dolly and tows it to the loading dock. Here, the shipping rack slides off the dolly and the grooved casters pick up an inverted angle rail on which it is pulled up the ramp by means of a cable operated by a geared winch.

WHEN the shipping rack reaches the "L" portion of the dock, the rack is resting on a transfer "car" that carries it sidewise to alignment with angle rails connecting with the rails inside the special railroad car.

From there the shipping rack again moves forward on inverted angle rails leading into the box car.

Clearances are extremely narrow. As the shipping rack enters the car, there is only 2-½ inches of space on each side and 2-½ inches from the top of the open doorway.

Inside the rail car, each of the two shipping racks is bolted down, leaving 2 inches clearance between the tanks and 2 inches at each end of the car.

In contrast with the old method of crating only two tanks to a car, there is obviously no waste space.

CERAMIC RESOURCES POOLED

(Continued from page 3)

of high temperature sheet metal components, Ryan has built a similar reputation in these fields.

California Metal Enameling Company has grown since 1905 to be the largest metal enameling firm in the west. Its key personnel, including President Joseph T. Penton, have a half-century of experience in highly specialized ceramic and porcelain enameling work. For many years, Cameo made approximately ten percent of all enamel signs in the United States.

MOST important investigation carried out since the Ryan-Cameo relationship began in 1950 is a flight test program arranged with Pan American World Airways. Ryan fabricated exhaust components, using a variety of alloys, and had them ceramic coated by California Metal Enameling. These assemblies were placed on the powerful 3500 h.p. engines of Stratocruiser aircraft used in trans-Pacific flights and are now approaching 2000 hours of service test under actual flight conditions.

Periodic examinations of these test units in the development laboratories verified the life-extending benefits of the new technique and established Ryan and Cameo as the leading authorities in its application to the aircraft industry. In filling the substantial orders which resulted from the development work, the two companies have become the first to produce ceramic coated parts in large volume.

Experimentally, combustion chambers and transition liners for the General Electric J-47 jet engine have been ceramic coated and preliminary analyses of test results are very encouraging. Production orders for piston engine exhaust systems

(Continued on page 22)

LIMBACH NAMED WORKS MANAGER

Lawrence M. Limbach, 41, formerly Manager of Operations, Steel and Tubes Division, Republic Steel Corp., Cleveland, has been appointed Works Manager of the Ryan Aeronautical Company, G. C. Woodard, Executive Vice-President, has announced.

The position of Works Manager has been reactivated due to Ryan's increased volume of production. Division Managers of the activities which will report to the Works Manager have, in the immediate past, been directly under Executive Vice-President Woodard, to whom Limbach as Works Manager now reports. These include the Production Division and the Factory Services Division with their main direct supporting departments. Managers of the Production and Factory Services Divisions are H. J. van der Linde and H. P. Rasp, respectively.

LAWRENCE M. LIMBACH

A native of Massillon, Ohio, Limbach is a graduate of the Staunton Military Academy, and of the Case Institute of Technology, in Metallurgical Engineering. He started with Republic in 1933 as an apprentice in the same division he headed when, last month, he left that firm's employ after 19 years. He served successfully as Assistant Chief Metallurgist, Assistant Manager of the Division's Elyria, Ohio plant, Assistant Manager and Manager of the Cleveland plant. The division, producing tubular products, comprises four plants with 2000 employees, at Cleveland, Elyria, Detroit and Brooklyn, New York.

CERAMIC RESOURCES POOLED

(Continued from page 21)

are being fabricated for the entire fleet of Boeing Stratocruisers in the services of Pan American, Northwest Airlines, British Overseas Airways Corp., United Air Lines and the Military Air Transport Service.

Ceramic coated exhaust system components are also being built for fleets of Convair 240s operated by American Airlines, Pan American, Western Air Lines, Continental Air Lines, Northeast Airlines and Mid-Continent Airlines.

Experimental orders have been received from Pratt & Whitney for complete ceramic coated exhaust manifolds for the R-4360 engine which is used on Boeing C-97 and B-50 aircraft and Convair B-36 bombers. Experimental work is being conducted with the Douglas Aircraft Company and United Air Lines on ceramic coatings for DC-6 exhaust systems.

On ground equipment, Ryan and Cameo are fabricating thousands of ceramic coated sections for the Ryan manifolds which serve the Continental 810 h.p. engines in General Patton M-46 and M-47 medium tanks.

The introduction of ceramics, an art known to the ancients, to the field of modern aviation power plants is the most promising metallurgical development in many years. Having led the aircraft industry in the verification of this new technique, Ryan and California Metal Enameling are merging their knowledge and facilities to meet the demands of rapidly expanding production.

TEAM-MATE FOR A TANK

(Continued from page 18)

fantry to front lines behind tank spearhead attacks.

At first glance the T18E1 looks like a formidable tank itself, and will undoubtedly be a welcome sight to the men of the ground forces who are assigned to exploit tank penetrations of enemy positions. In the field, it may operate with such big-gunned rolling fortresses as the General Patton M-46 medium tank, which also contains a Continental engine and Ryan exhaust system components.

Ryan ball-and-socket assemblies are used in these armored personnel carriers to provide flexible exhaust gas connections between the power plant and the chassis. These universal joints are an exclusive Ryan-patented device which has been incorporated in thousands of aircraft exhaust systems with outstanding success.

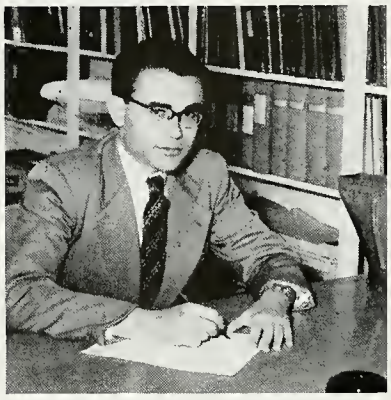
Each ball-and-socket assembly consists of a stainless steel tube, flared into a cup at one end to retain a cast metal ring which is circular in exterior contour. Inside this "ball" another stainless steel tube is inserted and flared to fit snugly, forming an integral joint which permits angular movement in all directions.

For the T18E1, Ryan provides two types of these assemblies: a 3-inch diameter joint and one which is 4⅜ inches in diameter. In the smaller unit, the cast ball is made of Ni-resist—an INCO alloy tailored to withstand high temperature. In the large assembly, the cast ball is made from a new alloy, especially formulated by the Ryan Development Laboratories.

Named "Rynalloy," this newly-devised metal has been specifically created by Ryan metallurgists to meet the exacting requirements of ball-and-socket joints. It will withstand oxidation at elevated temperatures running to 1800°F., or approximately 300°F. higher than Ni-resist. This is important to the function of the joint because oxidation causes scaling which tends to interfere with the free movement of the unit.

This high efficiency of the Ryan joint is attained by precision machining the cast balls and closely fitting them within the stainless steel tubes. It requires top caliber tooling to accomplish this in the punch presses. Both end and side clearances between the ball and tubes must be carefully controlled to provide flexibility but prevent gas leakage.

By design, the coefficients of expansion of the cast balls and the stainless steel tubes are similar. But, the manufacturing clearances in the joint are prescribed to take advantage of the differences in temperature between the inside and outside of the assembly. Since the joint is relatively thick, with the ball acting as a partial insulator, there is a difference in temperature between the ball and the inside and outside tubes. As the joint heats, the ball expands more snugly into the socket to form a leak-resistant joint. At cold temperatures, a greater clearance is available to permit more freedom of movement during engine warm-up.



Ceramic Engineer Joins Ryan

Alexander Pechman, ceramic engineer, has been added to the staff of the Ryan Development Laboratories in an expansion which marks the growing importance of this new field. A graduate of North Carolina State College, one of the few colleges equipped to grant Bachelor of Science degrees in ceramic engineering, Pechman has been trained in high temperature applications.

His specialized experience will be devoted to Ryan's program of testing, impraving and developing ceramic coatings for jet, rocket and internal combustion engines. His services will also be available to Ryan customers for technical counsel on new ceramic applications.

Pechman comes to Ryan from the Cook Ceramic Manufacturing Company of Trenton, New Jersey where he played a praminent part in the development of ceramic insulating bodies for electrical applications. These components were required to have high electrical insulating characteristics, law coefficients of expansion and good resistance to elevated temperatures.

Prior to his work with Cook, Pechman was associated with the National Bureau of Standards in Washington, D. C. where he performed laboratory research on government projects. He took part in the testing of special silicone paints and the enameling of components for a new bomb sight.

He is a member of the American Ceramic Society and Keramos — the national ceramic honor society.

THE engine selected for the personnel carrier is one of the Army Ordnance's newest light-weight power packages. It is a six-cylinder, air-cooled power plant from the same Continental family which provides the drive for the General Patton M-46 medium tank, as well as a number of other military vehicles. These engines have been developed in a variety of sizes, with interchangeable parts, to simplify field maintenance and repair. Used with an ingenious cross-drive transmission, they will give the 20-ton T18E1 the same speed and shift maneuverability which has been designed into the Army's medium tanks.

For fast entry and egress, two large swinging doors are fitted to the carrier's rear bulkhead. Other valuable uses for which the vehicles are well adapted, are transporting litters and cargo, towing artillery and providing mobile command post facilities.

1951 WAS A BUSY YEAR AT RYAN

(Continued from page 14)

rations which they own, the dividends which individual shareholders receive are also taxed by the federal government.

In recent years, there has been much criticism of corporation earnings by many government officials in Washington, but the fact is that under present tax laws, it is Washington which finds itself in the vested interest position. Without the operation of the country's leading industrial organization on a profitable level, the government would be unable to collect from corporations the taxes which go far toward providing funds for the huge spending program of the federal government.

The lower ratio of Ryan's earnings to sales for 1951 was due principally to abnormally high costs resulting from the rapid production build-up on new military products. Paid and charged off as incurred in line with Ryan's policy, these costs included rearrangment of plant areas for more efficient production, extensive tooling for larger manufacturing volume, recruiting and training new employees, and expansion of outside production, purchasing, inspection and other "overhead" functions.

Another factor affecting earnings was that most of the 1951 business was obtained before the Korean War, at fixed prices. Since then, labor and material costs have increased far beyond anticipated levels.

Large capital expenditures for buildings, equipment and other facilities were made in order to enable Ryan to carry its share of the defense program and to assure future growth. More than $1,250,000 in profits of former years, which stockholders had re-invested in the business, were used to keep the plant modern and to handle the increased orders. This included $430,000 for the new jet engine parts building and other structures, expanding total production space to 730,000 square feet; and $825,000 for new machines, tools and other production equipment.

More than half of last years' earnings, or $205,683, was reinvested in the business. Cash dividends to shareowners were $196,921, or about 49 cents out of every dollar of earnings left after taxes. The "take home" cash dividend of the average stockholder among Ryan's 1100 owners was about $179 for the 12-month period.

For every dollar paid out last year to owners in dividends, $58.17 was paid out in wages and salaries to employees; and for the year the payroll totaled $11,454,281. This $11½ million permitted Ryan employees to buy homes and furniture, education, insurance, food and clothing —thereby helping make local business prosper. As one of the large employers in San Diego, Ryan's payroll is for the most part spent here, adding to the high level of prosperity and standard of living most San Diegans enjoy.

For materials, supplies and services, Ryan paid out nearly $9 million last year to a broad cross-section of industry which furnishes materials such as steel, aluminum, instruments, paint, castings and so forth; and services such as heat, light, gas, printing, telephones and the many other daily needs of a large factory. The money for materials was spent in practically every state and helps to make business better and provide more jobs in every section of the country. Many of the services Ryan buys are furnished by local firms and contribute to the welfare and prosperity of the San Diego area.

Due to the larger volume of work, more money had to be tied up in materials for production, in parts being manufactured and in bills not collected from Ryan customers. Since the company had insufficient cash to finance these accounts, it had to obtain a line of bank credit of $12,000,000. Of this amount, $10,500,000 has been borrowed to help finance current operations.

During the year, the company augmented and diversified its activities and products, and remains on top of technical developments in its field. Security regulations, however, cloak details of prime research and development contracts for the Air Force and Navy, which are important to the company's future.

Despite rising production costs and a profit margin lower than in the corresponding period of 1950, the net worth reached an all-time high of $5,217,072 at the fiscal year end. The book value per net outstanding share stood at $13.25, compared with $12.72 at the start of the period.

Much of the high starting load and tooling costs incurred in building up to increased volume were absorbed by the year end and, as higher output is reached, an improved earnings ratio is being reflected. Unaudited figures for the first quarter of fiscal 1952 show net earnings after taxes of $164,446—equivalent to approximately 42 cents per share, and justify the optimistic outlook predicted in the annual report . At January 31, 1952, the stockholders' equity had increased to $13.55 per share.

Production volume is now at the highest rate in seven years and will continue to increase on the basis of present orders. However, it will be 18 to 24 months before the full benefit of Ryan's increased production capacity is realized.

"In America, Almost Everybody Is a Capitalist"

This statement is apt to greet you in any number of places during the week of April 27-May 3, for that's when thousands of Southern California communities, businesses, civic groups, and just plain citizens, will emphasize the role of American capitalism as the theme of an event called Invest in America Week.

The statement proclaiming that most Americans are capitalists is likely to be followed by one of a number of factually accurate explanations, one of which goes like this:

"The simple truth is there are about three capitalists for every job holder in the country—and often the job holder himself is one of them. This somewhat startling fact is borne out when you consider that all 160 million Americans are capitalists. On the other hand, only about 60 million of these American capitalists are job holders."

The explanation goes even further. "An average investment of $6000 was made by some individual, or group of individuals, to make possible every job in this nation. It is not the wealth of millionaires that has made these jobs possible, but the accumulated savings of millions of Americans. These are the capitalists of the nation."

Not enough Americans understand the importance of the stake they have in the U. S. economic system. The 86 million people who have life insurance, the 60 million who have money in the bank, the 15 million Americans who have invested directly in the securities of great American industries, are the ones who supply most of the jobs.

When individual company statistics are examined, the figures become even more astronomical. One of the West's leading companies, with over 5000 employees, has seven owners for each job. These owners are the stockholders. Another, a large financial institution, has 12 owner-stockholders for each employee. A third outstanding example is that of the Bell System, with over 500,000 employees, the company has more than one million individual stockholders.

What all of this adds up to, is simply that "In America, Almost Everybody is a Capitalist."

MISSILE GUIDANCE

(Continued from page 9)

far more a development problem than a basic research problem. As a consequence, great emphasis has been placed in the program on missile proving grounds and test programs, for the ultimate performance of a missile depends substantially on the extent to which all of its various elements have become compatible with each other, rather than how well each element performs unto itself.

If we assume that an enemy bomber is traveling at 600 mph at 45,000 ft., in the 15 sec. required for the missile to reach that altitude, the bomber will have covered 13,200 ft., or 2½ miles. During that 15 sec. the bomber pilot will have to keep the bomber exactly on course with an accuracy of one part in 10,000 — obviously extremely unlikely. If the bomber deviates from its course by only one-half degree, the conventional preset missile will miss it by 106 ft. It is clear that if interception is to occur, some method of re-directing the missile after launching is essential.

COMMAND GUIDANCE

The simplest system of control is Command Guidance, in which signals from the ground are transmitted to the missile in flight. In this weapons system, the enemy bomber and the missile are continuously tracked by radar; changes in the bomber's course are detected and the variation in the missile flight path to a new line of intersection is automatically computed and radio signals are transmitted to the missile which move its controls to bring it to the new collision course. This may have to occur a number of times in the 15 sec. flight, reflecting the absolute necessity for very fast-acting equipment.

BEAM-RIDER GUIDANCE

Next most complicated system is the Way-Following Guidance, or "Beam Rider" system. In this system, a radar beam is transmitted continuously at the bomber and equipment is contained in the missile which enables it to follow this beam to the target. This equipment not only detects when the missile is directly on the beam (which, itself, will be continuously moving with the bomber) but, also, the direction and magnitude of its error when it is off the beam.

HOMING GUIDANCE

Further complicated is the Homing Guidance system in which the missile "homes" on the bomber. This system may take a variety of forms. In Active Homing systems, all of the necessary equipment is contained within the missile; i. e., it transmits a radar signal to the bomber, receives the reflected signal which is used to actuate the missile control system. In Passive Homing systems, the missile receives radiations emanating from the target. A further type is the Semi-Active Homing system in which the radar signal is sent from the ground (or a friendly airplane) and only the reflected signal is received in the missile, which adjusts its course thereby.

With these three basic systems of guidance established, it is possible to examine each in detail to establish individual design requirements. The guidance system must work in complete harmony with the stability and control characteristics of the missile and these two characteristics are inseparable.

IT WAS stated previously that the guidance system must be quick-acting. This is comparatively simple to attain. But after the required corrective signal has been obtained from the guidance system, it must be used to actuate a control surface and the missile deviate from its course. As is well known in piloted aircraft work, movement of a control surface immediately creates an oscillation in which the axis of the aircraft swings past the desired course in both directions until the oscillation is damped out by the stability characteristics of the design. The rate and amplitude of these oscillations, while predictable in the design stage, varies with such minor considerations as manufacturing techniques, the center-of-gravity of the model (which is constantly shifting due to propellant burning), and even atmospheric conditions (temperature, pressure and density). Since tactical missiles will never be fired straight up, even sleek, wingless missiles will develop lift and their weight components will be inclined at progressively-changing angles, both requiring corrective action from an automatic stabilizing system quite apart from the guidance system.

It is clear that the guided missile is not the single unit weapon popularly supposed but is, instead, virtually a whole new field of human endeavor. The majority of the problems it has created have no exclusive connection with a destructive missile but are simply technical progress at an accelerated pace along familiar electrical and mechanical design lines. As a consequence, impatience with this nation's guided missile program is actually impatience with the whole gamut of technological progress for there is assuredly no field of electronic, aerodynamic or mechanical scientific endeavor that does not have applications to the guided missile development program. Likewise, there are few developments in the guided missile field which do not have manifold applications throughout the general industrial field. As such, America's guided missile program is actually the sum total of America's scientific progress and, as a consequence, its pace can never be accurately criticized as slow. It is the inevitable never-to-be-rushed pace of science.

TYPES OF GUIDED MISSILES

AAM — Air-to-Air Missile (used by one aircraft in attack on another)

ASM — Air-to-Surface Missile (powered, guided aircraft bomb)

AUM — Air-to-Underwater Missile (powered, guided aircraft bomb used in Anti-Submarine Warfare)

SAM — Surface-to-Air Missile (anti-aircraft)

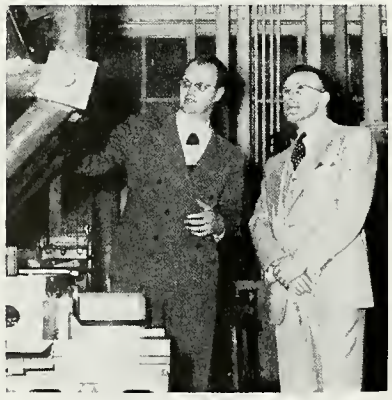
SSM — Surface-to-Surface Missile (artillery type; short-range types are tactical missiles, long-range types strategic missiles)

SUM — Surface-to-Underwater Missile (high-velocity, homing depth charge)

UAM — Underwater-to-Surface Missile (conventional torpedo)

A—Air; S—Surface; U—Underwater; M—Missile; A—Air Force; G—Army; N—Navy.

Example: Ryan XAAM-A-1 "Firebird"—Ryan experimental air-to-air missile for Air Force, first model.



EXPERT VISITS

Phillip Marsilius (right), Bridgeport, Conn. manufacturer of die sets and machine tools, was on loan to the National Production Authority when he toured the Ryan plant recently with Ernest Mellinger (left), executive assistant to the factory services manager, to gain first hand knowledge of how production tools are employed in the aircraft industry.

THE FATEFUL 60 DAYS

(Continued from page 11)

outlying field, and Lindbergh was on his way east as soon as he was satisfied the airplane would get off and climb.

Van der Linde and Harrigan, Ryan test pilot who helped conduct engine tests, used a Ryan M-1 as a "chase plane" to follow Lindbergh during the Lone Eagle's early flights over San Diego.

"One morning at 6, he disappeared in the fog over the bay," van der Linde recalled.

"We flew down close to the water when we lost him, and then circled back to the Ryan field at Dutch Flats, opposite the Marine Base. Just as we were coming over the power lines for a landing, Lindbergh came whizzing by us, also for a landing. Our wing tips were only 10 or 15 feet apart. We were scared stiff.

"Lindbergh had no straight ahead visibility in that plane. He couldn't see us. Another few feet in the wrong direction on that landing, and none of us would be here today."

Of all questions asked about the "Spirit of St. Louis," the most common, according to Claude Ryan, is:

"Why was the pilot's cockpit located so that Lindbergh couldn't see directly forward?"

It was realized that the greatest risk in the flight (assuming the 200 horsepower Wright Whirlwind engine didn't conk out over mid-Atlantic) would be in the takeoff, due to the extremely heavy fuel load.

Not long before construction was started on the "Spirit of St. Louis," two Frenchmen attempting a flight to Paris were killed when their plane crashed at the end of the Roosevelt Field, New York, runway on takeoff. The fuel tanks were located behind them, and the impact hurled the tanks forward, crushing the fliers against the engine.

"It was decided that Lindbergh would have a better chance to get out alive in such a crash if the tanks were placed forward of the cockpit," Ryan said.

"This meant eliminating all forward vision. But Lindbergh said, 'That's all right, I don't need to see straight ahead as I expect to have to fly mostly by instruments and there won't be much traffic over the Atlantic, anyway!'

"He was, of course, able to see out the side windows on a forward angle for landing."

Ryan believes one of the most important secrets of Lindbergh's success was his ability to fly by instruments, as he had to over the Atlantic through the overcast for hours, depending entirely on his turn and bank indicator, altimeter, air speed indicator, and compass to tell him his flight attitude.

Lindbergh had trained himself, as very few pilots of the day had, to fly depending on those meager instruments without outside references. On the night airmail run between Chicago and St. Louis flown by Lindbergh for Robertson Aircraft Co., he had taken advantage of the opportunity to find out for himself what the problems were of controlling and navigating an airplane on instruments alone, and to develop this skill of flying blind.

He would enter high clouds intentionally to train himself. It was like the present day method of practicing under the hood or in a Link trainer as is now required of all fully trained pilots.

"More than half of the transatlantic flight was through clouds," Ryan said. "Without Lindbergh's blind flying ability, he would have met the fate of so many other pilots who before and soon after his flight attempted trans-oceanic hops. They undoubtedly entered fog or dense clouds, let their planes get out of control and into spins, and never were heard from after takeoff."

Visibility in the "Spirit of St. Louis" was sacrificed for better streamlining and safety. By taking out the pilot's seat and front passenger seats in the original Ryan Brougham design, fuel and oil tanks could be installed in the vacated space with no air-drag bulges.

Lindbergh took quite a ribbing about this lack of forward visibility. One of the Ryan employees developed a periscope which would help Lindbergh watch for other planes on the field at least while he was taxiing. It was not put to practical use.

The other major problem, that of wing loading, was solved by adding two feet to each wing tip of the Brougham design, which had a 42-foot wingspan. This sacrificed a slight amount of speed on the later part of the flight, but Lindbergh agreed it was advisable to reduce the critical wingloading for takeoff.

"I doubt if he'd have gotten off Roosevelt Field that morning without the extra four feet," Ryan declared. "There was no wind, and experienced pilots were almost certain he wouldn't make it. The plane wobbled quite a bit, and it didn't look as though he'd leave the ground. But the extra margin provided by the larger wings finally lifted the 'Spirit of St. Louis'."

One of Lindbergh's worries while the plane was under construction in San Diego was whether he'd be able to stay awake throughout the flight, his nerves dulled by the monotonous roar of the engine.

He conditioned himself by taking long solitary walks at night, or by sitting on the beach for hours. The problem prompted numerous suggestions from the Ryan workers, one of whom proposed a Rube Goldberg device consisting of an alarm clock that would periodically activate a needle to jab Lindbergh in the seat of his pants.

A retiring, quiet fellow even then, Lindbergh took the good-natured kidding in the spirit it was intended. But he didn't withdraw entirely into himself. He loved a practical joke, and took keen delight in playing tricks on some of the company officials, such as awakening them by phone calls at late hours and asking for a fictitious character, to liven things up for the workers who labored far into the night, battling a 60-day completion deadline.

Walter O. Locke, assistant to the president today, did everything from purchasing materials to production control on the "Spirit of St. Louis," and he recalls Lindbergh's faith in the engineers and shop crew as they figured how the airplane should be built.

"As problems arose, Lindbergh was consulted regarding suggested solutions, but once a decision was reached, he never requested that it be changed," Locke said.

"He was at the plant nearly all the time while the plane was being built, but most of his attention was centered on studying charts, plotting his course, and otherwise preparing for the flight.

Publicity then, as today, was dodged by the Lone Eagle. He would have been satisfied with no mention of his preparations for the flight. His social life here was almost nil. Although civic clubs invited him to attend their luncheons and dinners, he rarely accepted.

The dangers of his adventure were viewed by him in a matter-of-fact light. At one of the rare public gatherings he attended in San Diego—a meeting of Sciots—he was asked:

"What if your engine quits?"

Lindbergh replied simply: "'Oh, that would just be too bad."

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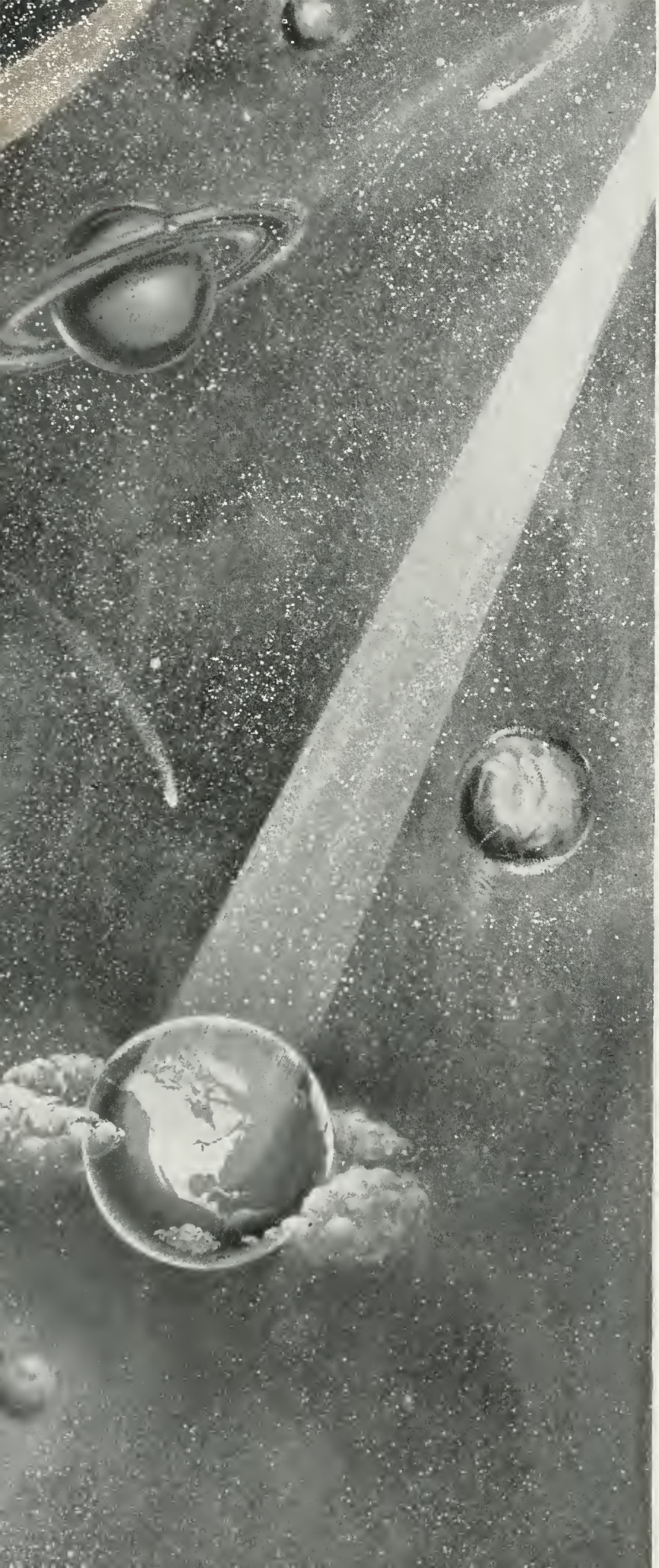


Why Did It Happen Here?

I

What happened during the last 200 years to that part of North America now called the United States?

And why did it happen here instead of some other part of the world?

Our forests, streams, plains, valleys, and mountains have been here for some twenty-five thousand years without change.

The people called Indians who had come to North America through (and possibly from) Siberia spent at least ten thousand years in unchanging squalor and in constant danger of famine.

All over the world man's material welfare had stood still: life was short and hard, mother nature was a stingy provider, demanding her pound of sweat for everything she gave up.

Food, clothing, shelter, and crude comfort represented so much of a problem that virtually all of man's time was consumed in working to get them.

It could truthfully be said that from all appearances the human race had no economic future.

II

Then came the second migration to North America, this time by people from Europe instead of Asia.

They brought something with them that had never been here before; in fact, it had never been tried out, even in Europe.

It wasn't anything physical — it was an IDEA: the idea that there should be a country where every man should be free to pursue his full measure of happiness and prosperity and where government should exist only to serve the people.

This idea had started with the teachings of a man known as Jesus Christ, but

(Continued on page 23)

BLIMP BLANKET

Ryan heat exchanger is fuel-less fireplace for blimp crews

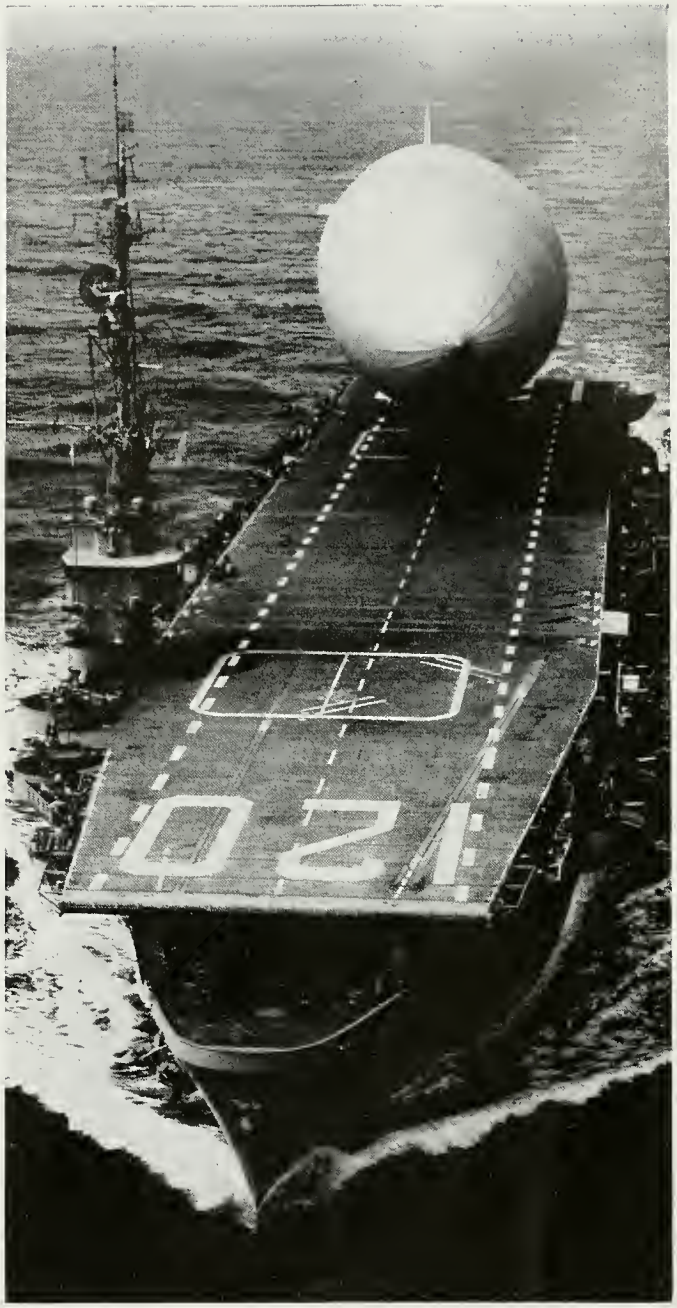
RYAN exhaust heaters have gone to sea. To provide cabin comfort for blimp crews on anti-submarine patrol, the Navy's ZP2K airships are being equipped with Ryan heaters as they return to active service with Fleet Airship Squadrons. The backbone of the Navy's lighter-than-air arm, K-type blimps are an important member of the "hunter-killer" teams used to seek out and destroy enemy submarines.

Post-war submarine improvements, such as the snorkel breathing device, have made these undersea craft more difficult to detect. The Navy is meeting this challenge with a coordinated attack team consisting of surface vessels, planes and Goodyear blimps. In this trio, the blimp role is usually that of a "hunter" because of its ability to carry a great deal of electronic detection gear. Its unexcelled endurance and maneuverability make it a hovering "eye" of sharp perception. However, it can also become a deadly "killer" when occasion demands by bringing its machine guns, depth charges and other weapons to bear.

The Ryan heaters are actually light-weight heat exchangers which are attached to the blimp engines. Each heater is a circular cluster of eight stainless steel tubes contained in a cannular shroud. As the hot engine exhaust gases pass through the tubes, the air within the shroud is heated. This warmed air is channeled to the cabin through two floor vents, to maintain crew comfort on extended flights. The system saves the added weight of fuel and burners, ordinarily required, by harnessing exhaust heat energy which would otherwise be wasted.

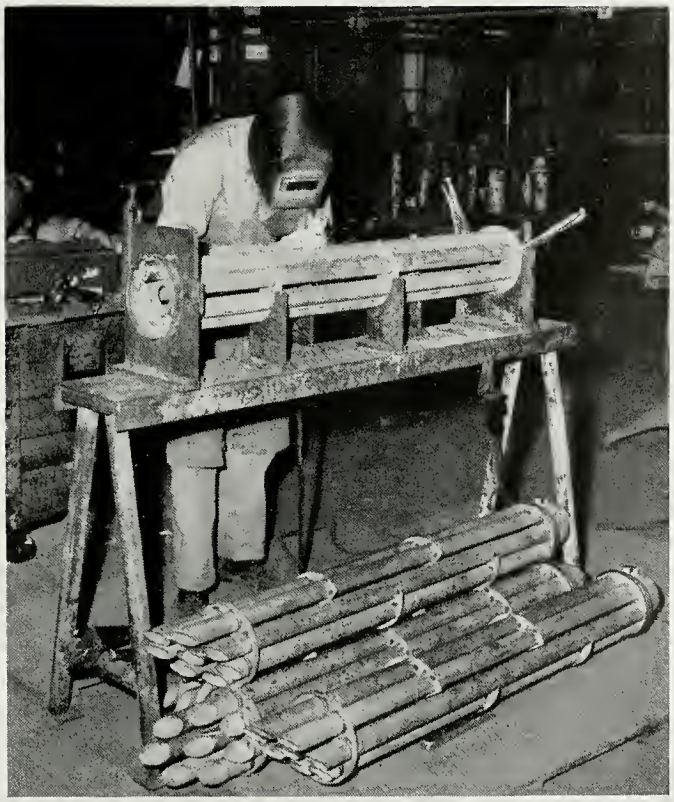
Despite an enviable war record of escorting 89,000 ships

(Continued on page 19)



Official U. S. Navy Photo

Blimp range, far anti-submarine patrol, is greatly extended by use af carrier as a mabile station for fuel and supplies.



Stainless steel tubes are arc-welded inta pattern by William Kairot to farm Ryan exhaust heater far Goodyear ZP2K blimps.

RYAN BUILDING WORLD'S LARGEST FUEL TANKS FOR BOEING B-47B STRATOJET

(See Front Cover)

THE world's fastest known bomber, the new Boeing B-47B, has increased its combat range considerably through installation of Ryan external fuel tanks, the largest ever mounted on an airplane, it has now been officially revealed for the first time.

The huge streamlined tanks, capacity of which remains secret, are under construction in mass quantities at Ryan Aeronautical Company, which has shipped large quantities to Boeing's Wichita, Kan. plant, where the "bomber with fighter speed" is in large scale production.

Suspended one under each wing, between the tip and inboard jet engine pods, the tanks will enable the B-47B's to complete long-range missions, carrying more than 20,000 pounds of bombs.

Another Stratojet feature extending its flight range is the mid-air refueling system, in which Ryan also plays a major role. Being built by Ryan are aft fuselage sections and refuelings pods for the Boeing KC-97 strato-tanker. An operator stationed in the pod controls a "flying boom" through which fuel flows in mid-air from the strato-tanker to the B-47B bomber.

Still another Ryan contribution to the effectiveness of the B-47B are many high-temperature components for the new series General Electric J-47 engines, which develop more than 5800 pounds of thrust each, compared with 5200 pounds of thrust for engines used on the earlier B-47 models. Tail pipes which carry the searing jet gases from the engine to the atmosphere also are being built on Ryan production lines.

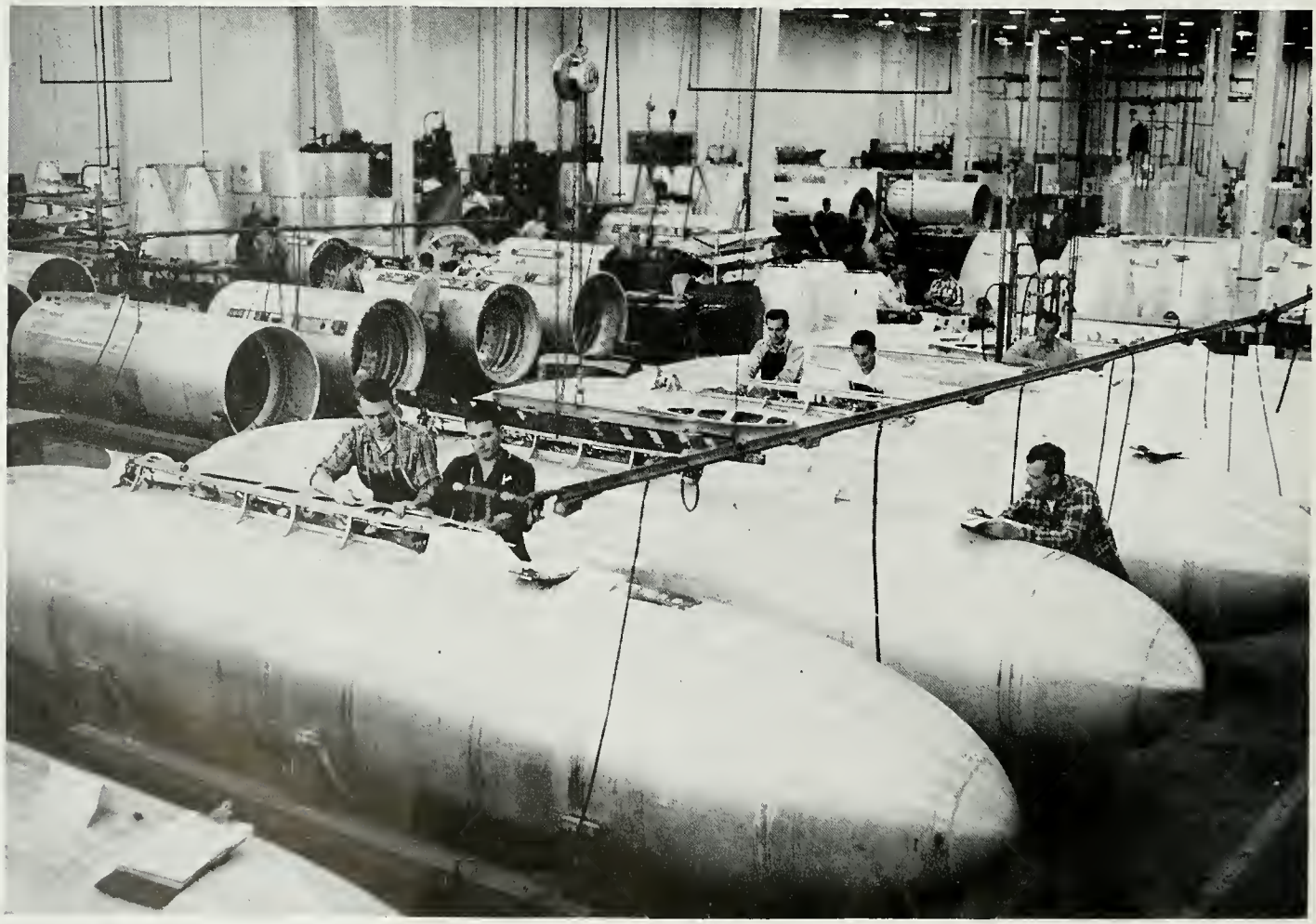
With the largest number of electric resistance welding machines in the industry, Ryan uses this equipment for joining the aluminum alloy sheets in the lightweight, torpedo-shaped fuel tanks.

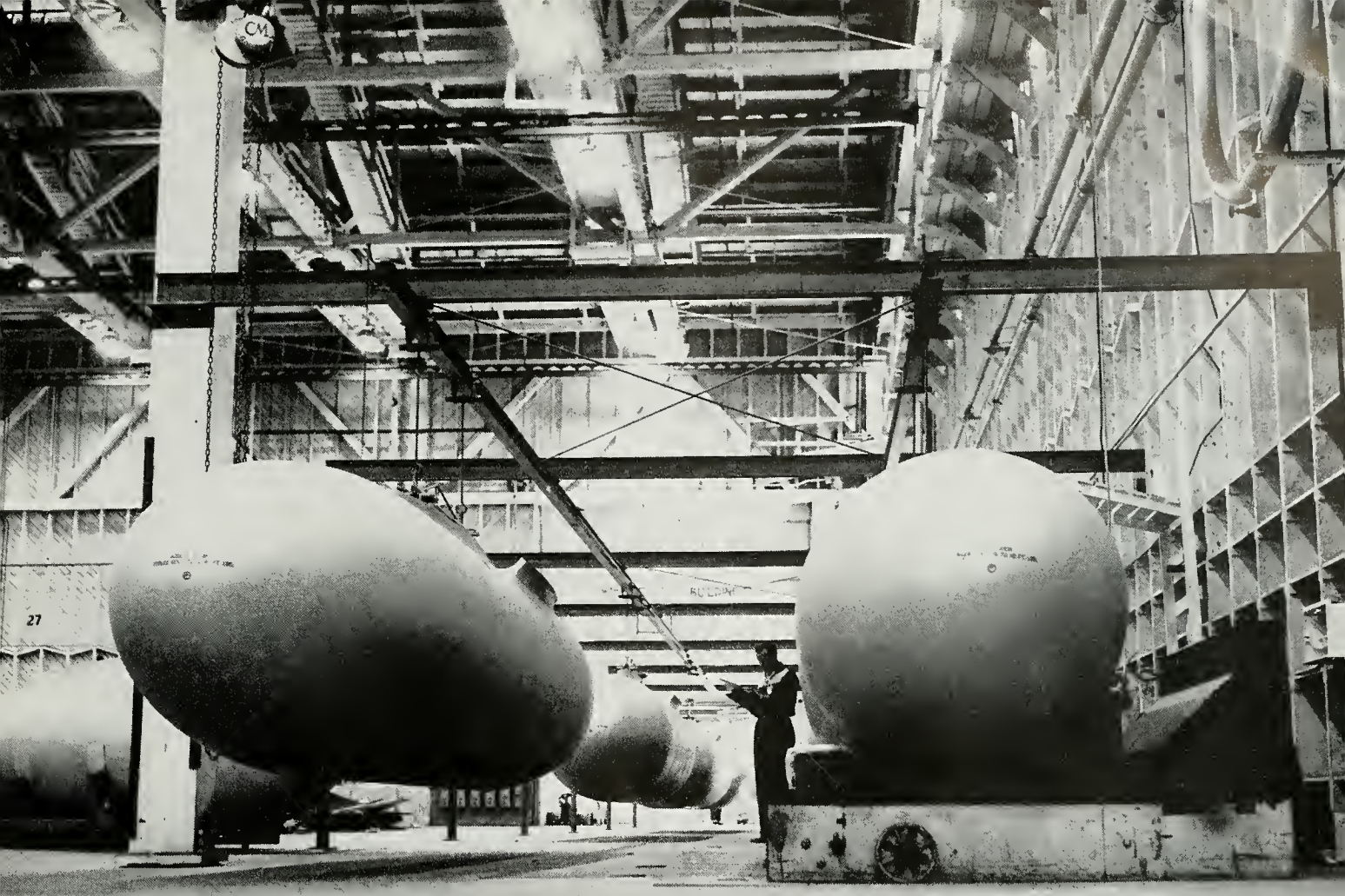
More than 30,000 electric spot welds are employed in each tank. All circumferential joints are closed with two rows of spot welds and one row of seam welding to attain a gas-tight seam. The single longitudinal seam, which runs through the individual tank sections, is fusion-welded on automatic Heliarc welding machines. This provides a strong, flat seam no thicker than the metal itself and does not require splice plates.

The giant spot welding machines can

(Continued on page 25)

Previously restricted, the huge fuel tanks rolling from Ryan production lines can now be identified as B-47B Stratojet wing tanks.





SLIP COVER

THE man who coaxes the top few miles-per-hour from today's fast combat airplanes may not be an engineer or an aerodynamicist — but a painter. High speed paint, designed to cover tiny surface variations with a smooth aerodynamic film, is pushing up jet aircraft speeds.

Ryan is adapting this development in the production of the world's largest external fuel tanks for aircraft. These mammoth containers, for Boeing B-47B long-range Stratojets, are given an exacting surface preparation which reduces their air resistance and adds to their protection against the elements. With this streamlining plus their fleet design, patterned after a wing foil section, the big tanks can "keep up" with the speediest planes.

Because the big fuel cells are built with more than 30,000 invisible spot welds, the tanks' exteriors are pretty smooth to start with. But not smooth enough to meet the silky slickness required for high speed flight. At jet aircraft speeds, even a fly on the surface could cause turbulence. Tiny scratches and bumps become mountainous obstacles which upset the smooth laminar flow of the rushing air stream.

First step in giving the tanks a slippery skin begins after final assembly and inspection. They are suspended in Ryan's large pressure-ventilated paint spray booth, from overhead monorail conveyors. Attachment is made by means of connectors which attach to the tank strut fittings. Thinner and alcoholic phosphoric acid solution are used to clean and slightly etch the aluminum alloy surfaces to provide good adherence for the primer. A coat of zinc chromate solution, which grips the metal and provides a slightly acid base for the next coat, is sprayed on. Then, a special synthetic rubber-base compound is sprayed on.

Formulated for its aerodynamic advantages, the compound also resists attack by aromatic fuels and is rain erosion-proof at high speeds. This is an important characteristic because, at the 600-mile-an-hour speed of the B-47B, rain drops can hammer painted surfaces with the destructiveness of small bullets. This simulated machine gun attack has been known to remove ordinary paint as effectively as a desert sand storm.

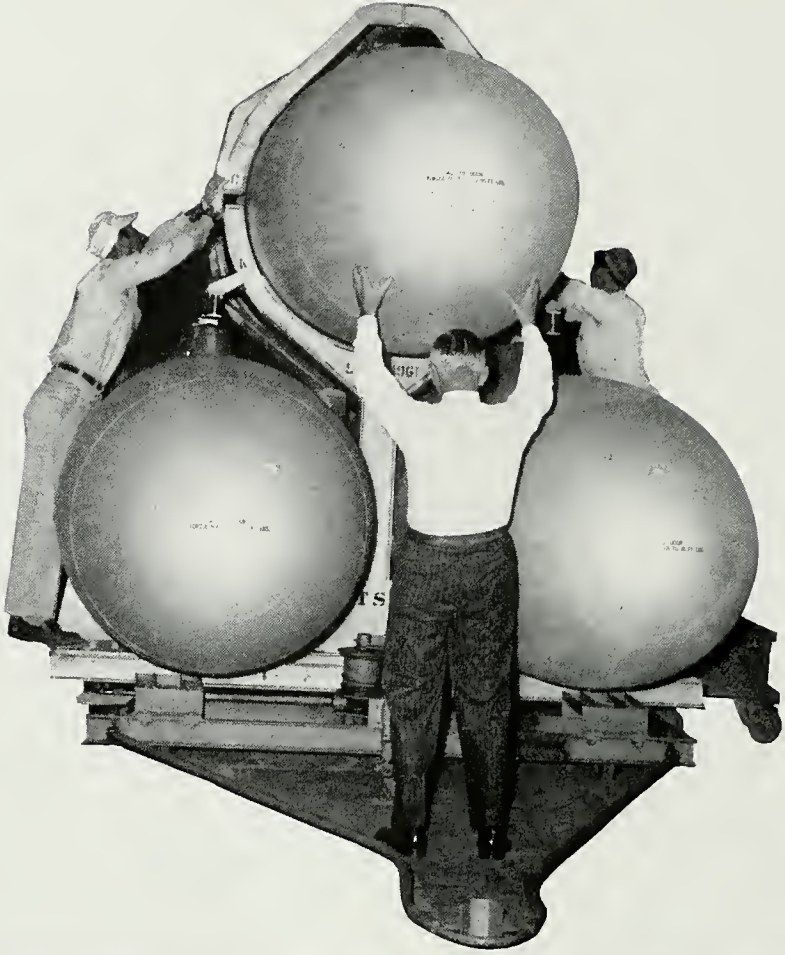
The preparation must be mixed immediately prior to its application and cannot be stored, even for a few hours, after mixing. It contains a goodly amount of powdered aluminum which "poisons" the resins in the solvent within a short time after it comes into contact with them. This causes them to jell and become extremely viscous. Also, as the aluminum flakes dissolve, they react with

(Continued on next page)

the resins to produce quantities of hydrogen gas which would accumulate excessive pressure in a closed container. A special mixing technique is employed to insure that the tiny aluminum flakes spread out in the resins and lie as flat as possible as they hug the fuel tank surfaces.

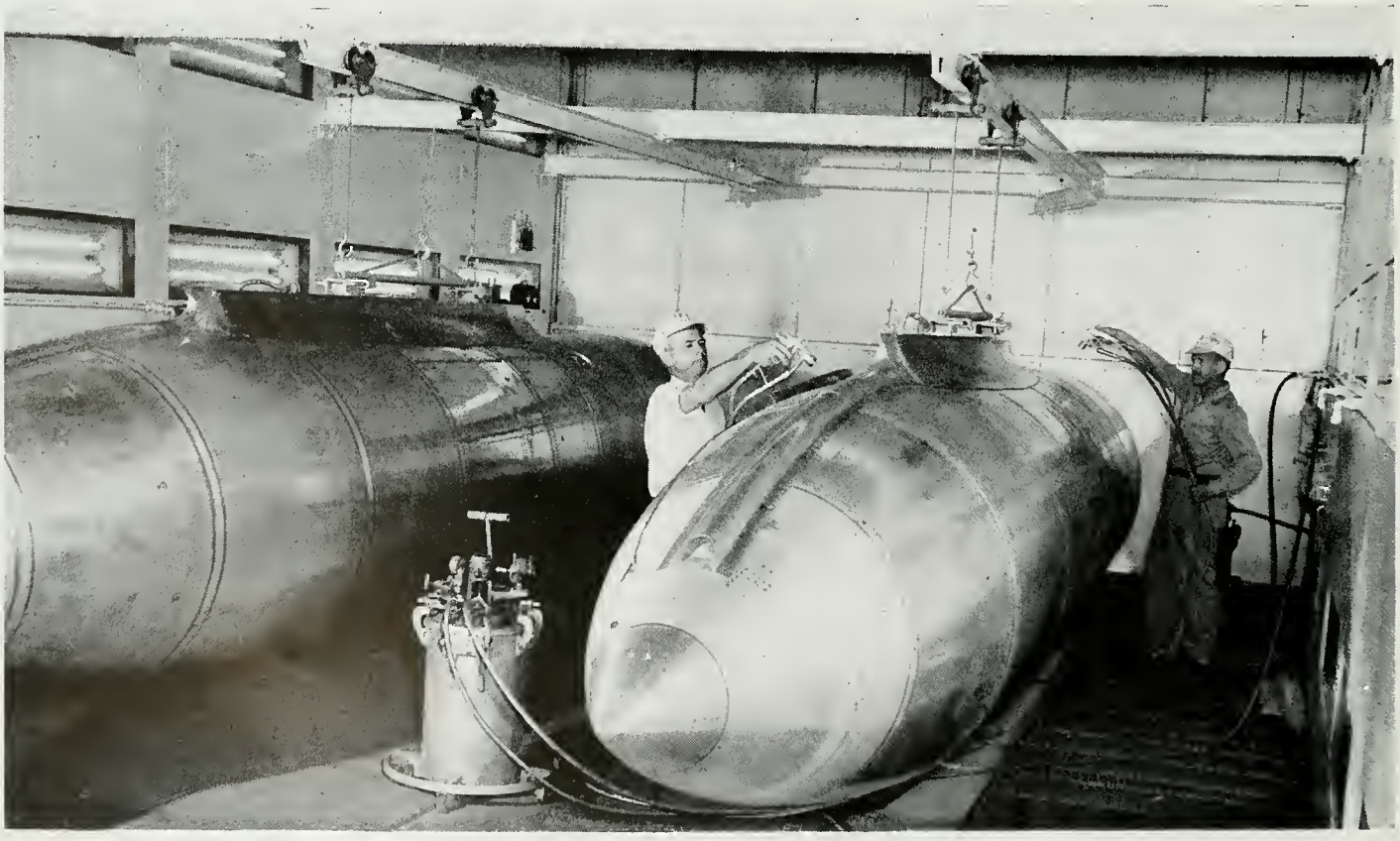
After spraying, the tanks are rolled out of the spray booth, on the monorail conveyors, into the final assembly building, They are wet-sanded and hand-rubbed until the finish is perfectly smooth. Instructions and fitting locations are stenciled on with vinyl lacquer—only paint which seems to adhere to the compound.

At the end of the conveyor lines, a crane, fitted with a dial-type weighing gauge, hoists each tank from the monorail. The exact weight is noted, en route, and the tank is placed in an inspection dolly. Here, it is given a minute, final inspection by Ryan, Boeing and Air Force inspectors. Then, the crane transfers it to a transportation fixture which holds three tanks. The complete assembly is towed to Ryan's railroad siding by small trucks. There, the fixture is hauled onto a tracked frame-work by means of a cable and winch. This frame-work is rolled sideways to align the fixture with the open doors of specially-built railroad cars. Two fixtures, containing six big tanks, are pushed into each car and the shipment from Ryan is on its way.



After final approval by Ryon, Boeing and Air Force inspectors, the big fuel tanks are lowered into cradles of specially-designed shipping dollies by means of a jib crane.

In heated, vented booth, Ryan painters Odell Lloyd (left) and Leonord Robor spray air-receptive compound on mommoth fuel tanks.



Actian of Ryan "de-corroder" is observed on instruments by Wes Vyvyan, right, project engineer, and Dick Preece, design engineer.

RYAN "DE-CORRODER" MODEL 57

A CONTRACT for development and testing of an exhaust gas converter has been received by Ryan from the U. S. Air Force. The order was placed with Ryan because of the company's specialized experience in the field of high temperature exhaust system engineering.

Known as a "de-corroder," Model 57, the Ryan device is designed to remove from exhaust gases the chemical contaminants which attack aircraft structural materials.

Utilization of the vast amounts of heat energy contained in the gases generated by aircraft power plants, for cabin heating, wing anti-icing and similar applications, has been hampered by the highly corrosive effect which these gases have upon aircraft metals such as aluminum and magnesium alloys. In relatively few hours of exposure the chemicals in the gases will penetrate these alloys to an alarming degree by corrosive attack.

Ryan crew which has been testing utilization of exhaust gases for various purposes is shown with test plane, Convair B-36.

The Ryan "de-corroder" has successfully demonstrated its effectiveness in removing contaminants so that the exhaust gases may safely be brought into contact with aircraft structures. This development has important significance to the harnessing of exhaust gas energy by making possible the design and use of lightweight aluminum alloy heat exchangers, ducts and piping. At present, many of these components have to be fabricated from stainless steels which results in substantially more weight than otherwise required.

Original research on the decontaminating unit was accomplished with extensive work which the Ryan engineering department conducted under previous U. S. Air Force experimental contracts. The new contract will provide for further improvement of the device and its development for use with both jet and internal combustion engines.

POWER PACKS For The C-97

Complete with tail-pipe and turbosupercharger take-off, this Ryan exhaust system towers over tool supervisor A. L. Hammock.

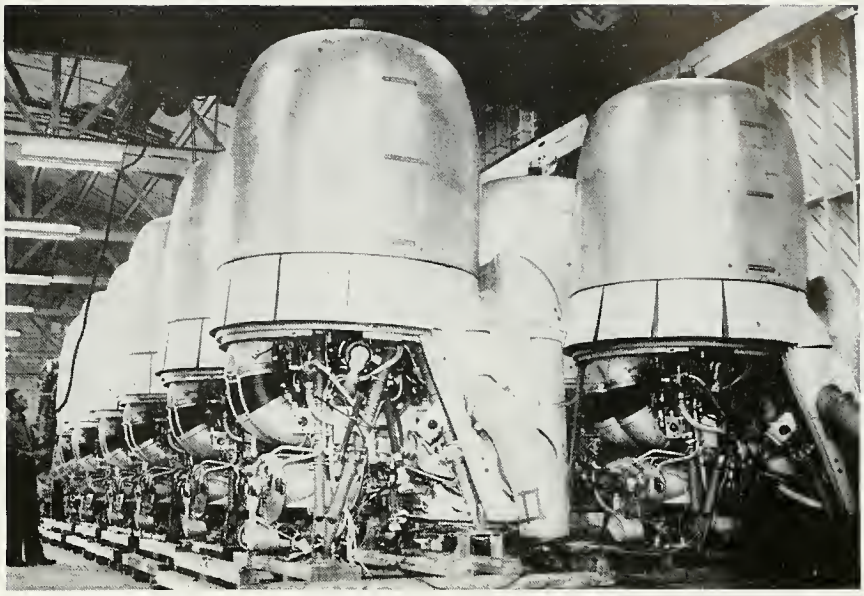
Rohr, Pratt & Whitney Aircraft and Ryan team up to deliver packaged power for Boeing's versatile Stratofreighter

A THREE-MAN team, each member a specialist in his field, works together to produce the complete engine and nacelle packages which power the versatile Boeing C-97 Stratofreighter.

The engine, a 3500 horsepower, 28-cylinder Wasp Major, Model 4360, is manufactured by Pratt & Whitney Aircraft. The exhaust system is fabricated from heat- and corrosion-resistant alloys by Ryan Aeronautical Company, a long-time specialist in the field of high-temperature aircraft engine components.

Rohr Aircraft Corp. takes the bare Pratt and Whitney Aircraft engine, Ryan exhaust system and other necessary accessories and puts them all together in an integrated nacelle which can be installed in the Stratofreighter in less than one hour.

Visualizing the benefits airframe manufactures would gain from a flow of ready-to-install packaged power units to their assembly lines, Rohr has transformed this idea into a commercial reality. Industry acceptance of packaged power has been stimulated by the aerodynamic requirements for "egg" and "pod" type power plants which stepped-up flight speeds have demanded.



Compressing a maze of accessories into unbelievably compact dimensions, Rohr power packages with Ryan exhausts are smoothly encased, readied for shipment.

The C-97 packaging program is one of Rohr's largest single projects. Using the Wasp Major engine as a foundation, Rohr specialists fit the precision-built Ryan exhaust system to its cylinder banks. Then, they install the myriad of electric motors, instruments, accessories, hoses, wires and tubes required to meet the complex needs of the engine.

A valuable aid in performing these installations is the ingenious Rohr Tilting Arc — a patented device which permits the ready suspension and rotation of the

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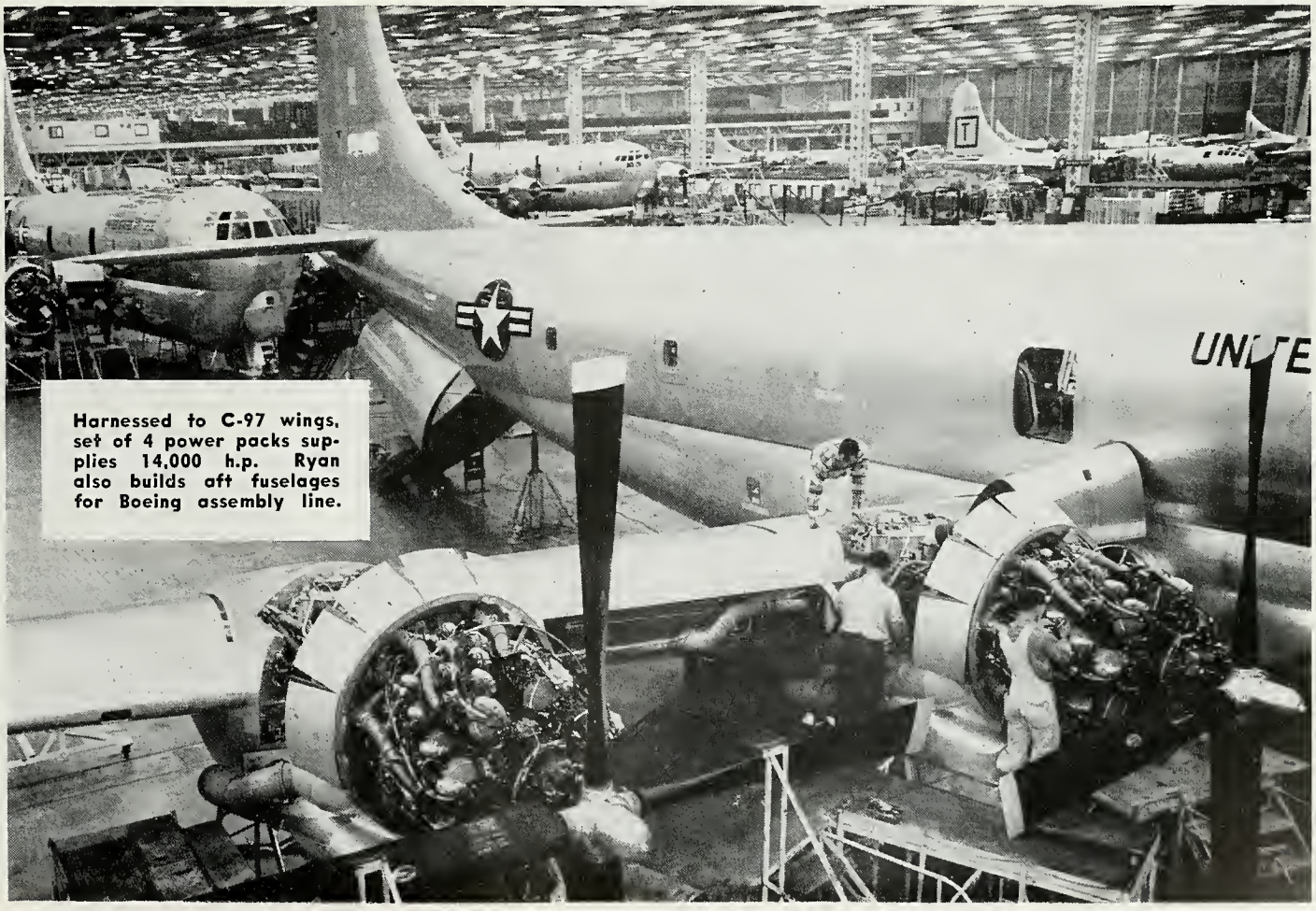


Harnessed to C-97 wings, set of 4 power packs supplies 14,000 h.p. Ryan also builds aft fuselages for Boeing assembly line.

MILLIONTHS FOR DEFENSE

Ryan "Bureau of Standards" pinpoints production

IN a small room, secluded from the roar of the Ryan factory, two mild-mannered men are quietly stacking small steel blocks. Their judgment affects the destinies of Ryan-built structures thousands of miles from the plant. They work with precision gauge blocks which measure in millionths of an inch.

In 1800, Noah Webster defined precision — but Webster had never seen a modern jet engine. When he was putting his dictionary together, a typical manufacturer worked in fractions-of-an-inch tolerances. Every part of an assembly had to be made and hand-fitted in the same shop or the unit would not function.

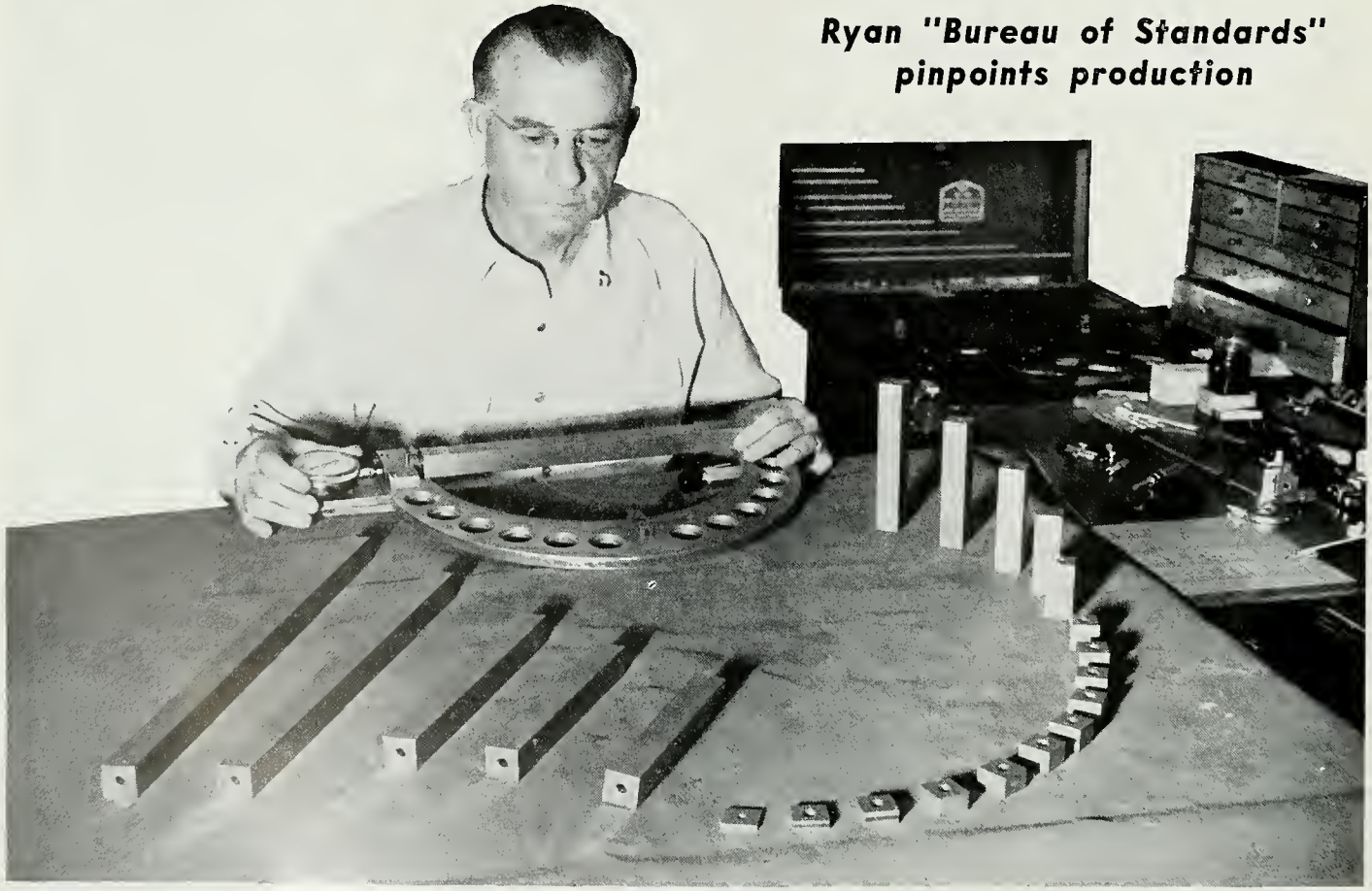
Interchangeability of parts was not even dreamed of until Eli Whitney went to Washington in 1809 to get an Army contract to make muskets. Taking the scrambled parts for ten muskets, he assembled them without regard for specific triggers, barrels and stocks and fired them with perfect coordination. This was the first demonstration of the theory of interchangeability to prove that identical parts could be built if a suitable standard of measurement were available. However, Whitney's parts would not fit other manufacturer's guns because there was no common basis for such measurement.

Today, a complex airplane, like the Boeing B-47B Stratojet, is made in thousands of plants scattered throughout the country. As the intricate parts flow into the Boeing assembly lines, they mesh with jewel-like precision. Ryan builds high temperature combustion chambers and exhaust cones and ships them to General Electric. There, they form the "hot end" of the J-47 power plant which whooshes the Stratojet along at more than 10-miles-a-minute. To Boeing, Ryan delivers the bazooka-like tail pipes of stainless steel which attach to the jet engines. Attaching bolts slide into place as smoothly as safe-door tumblers.

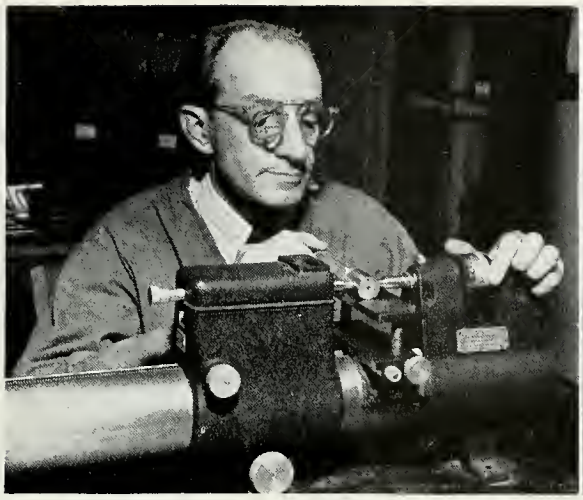
At Ryan, such interchangeability is the principal achievement of the men with the small steel blocks. Accountable directly to Chief Inspector A. S. Billings, they maintain the accuracy of the measuring devices which measure the parts that Ryan produces. In a larger sense, they operate Ryan's own "Bureau of Standards" to guarantee the high precision of each Ryan part and its perfect fit with other precision-built products.

The gauge blocks with which they work were originally designed in 1896. Completely unlike the kind that Junior plays with at home, they are amazingly smooth, flat rectangles of alloy steel. Varying in length from a twentieth of an inch to twenty inches, they are guaranteed to be accurate within 4 millionths of an inch. All of them have countersunk holes so that they can be tied together with steel rods to obtain more than 120,000 different measuring combinations.

Their mirror-like surfaces are so smooth that when two blocks are wrung



Using steel gauge blocks, wrung together, Maurice Whitcomb, Ryan precisionist, calibrates measuring devices to guide production.



William Haferkamp can check a plug gauge to one ten thousandth of an inch in this supermicrometer and arrive at even smaller measurements by estimation.

Typical Ryan parts which must be built to exact dimension are flanges for Boeing C-97 exhaust systems which George Tiedeman, inspection supervisor, is measuring. Surface must be smooth within 100 millionths inch average.

together they stick like glue. Two small blocks, with less than one-half square inch of contacting surface have been known to resist a force of 200 pounds to pull them apart. This phenomenon is due to the strong attraction of the molecules for each other when brought into such close contact and the cementing action of moisture from the air which is always present on block faces. To separate the pieces, you merely slide one off the other.

The steel from which they are made is alternately heat-treated and deep-frozen to stabilize it. However, the heat of your hand will cause the length of a block to change by as much as 40 millionths of an inch, if held tightly for several minutes. Room temperature changes do not distort measurements as long as the material being checked is steel. Since the blocks are steel, they will grow or shrink in the same infinitesimal degree as the metal measured. For other materials, a formula is used to determine corrections.

In the Ryan precision gauge room, the gauge blocks are used to check the accuracies of all micrometers, calipers, thread and holes gauges and other measuring instruments. At least once every three weeks these devices are calibrated and a permanent record is kept on each so that an instrument can be rejected before it reaches a predetermined limit of accuracy. A new gauge loses a few molecules of metal every time it is used. Ryan rejects most gauges when their accuracy slips to .0002 inch.

In many jet engine components, which

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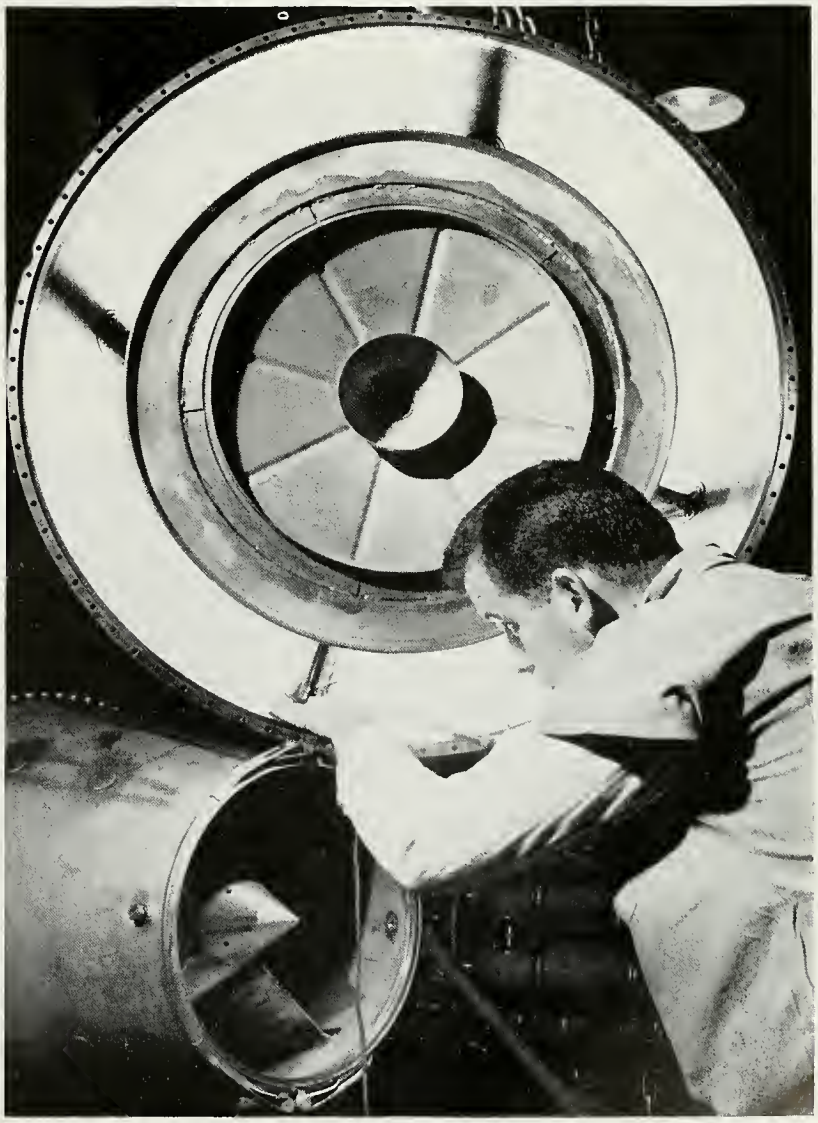
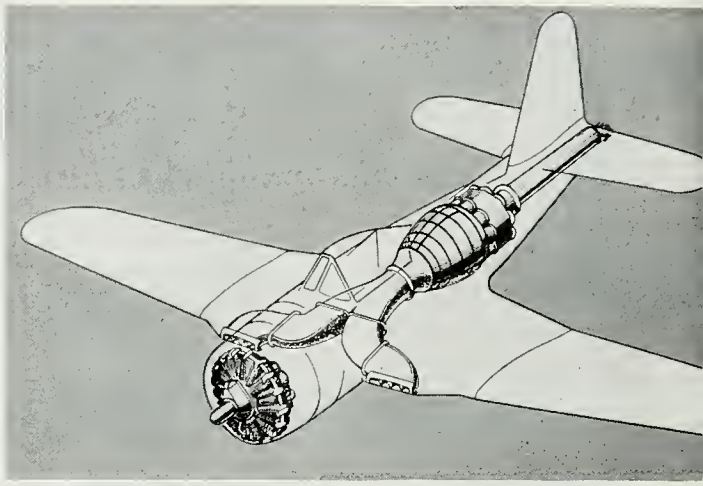
Precision-made Ryan exhaust cones are checked at General Electric plant before installation in J-47 jet engines. G-E inspector uses measuring instruments which are calibrated from same standard as Ryan "yardsticks"



America's first propellerless plane, the Bell P-59A Airocomet, flew with General Electric jet engines to launch a new era in locomotion.



Using G-E jet and Wright piston engines, Ryan FR-1 Fireball w first Navy jet plane and world's first jet-plus-propeller typ

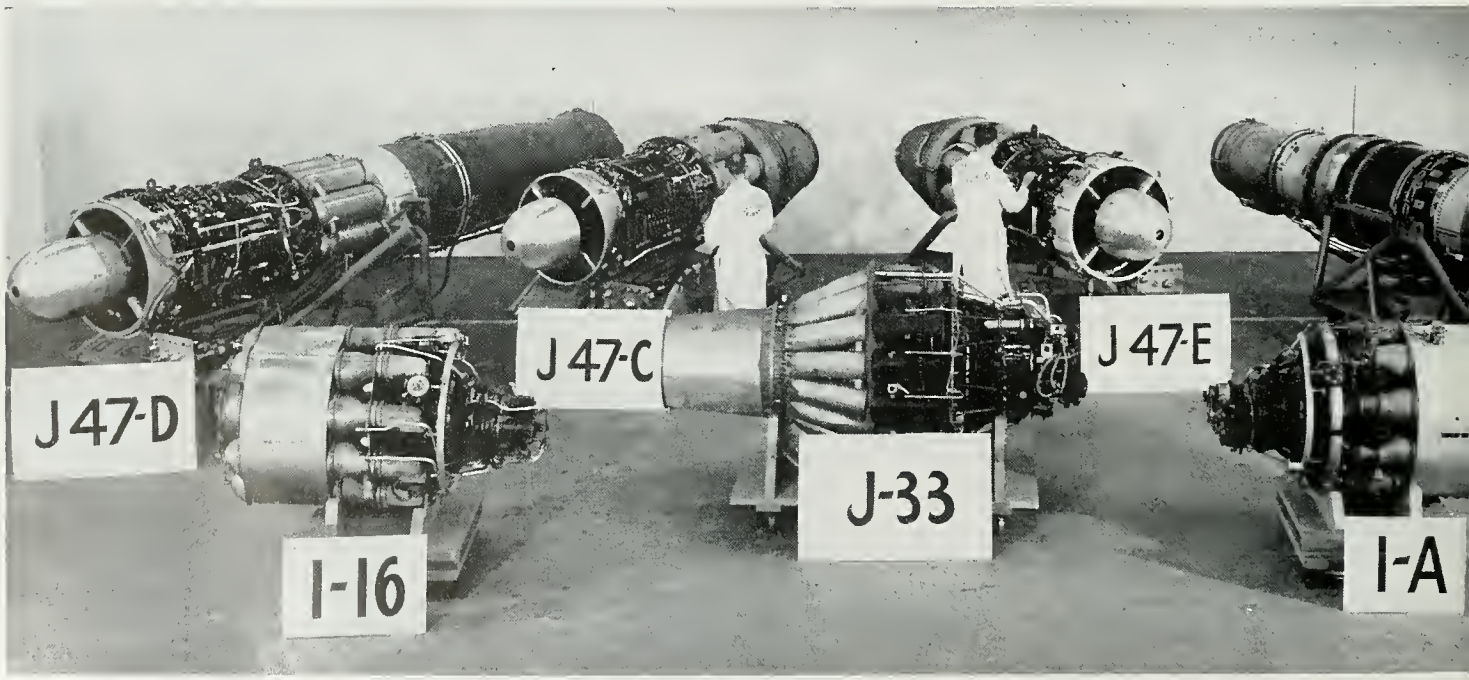
Fastest 10 Years In History

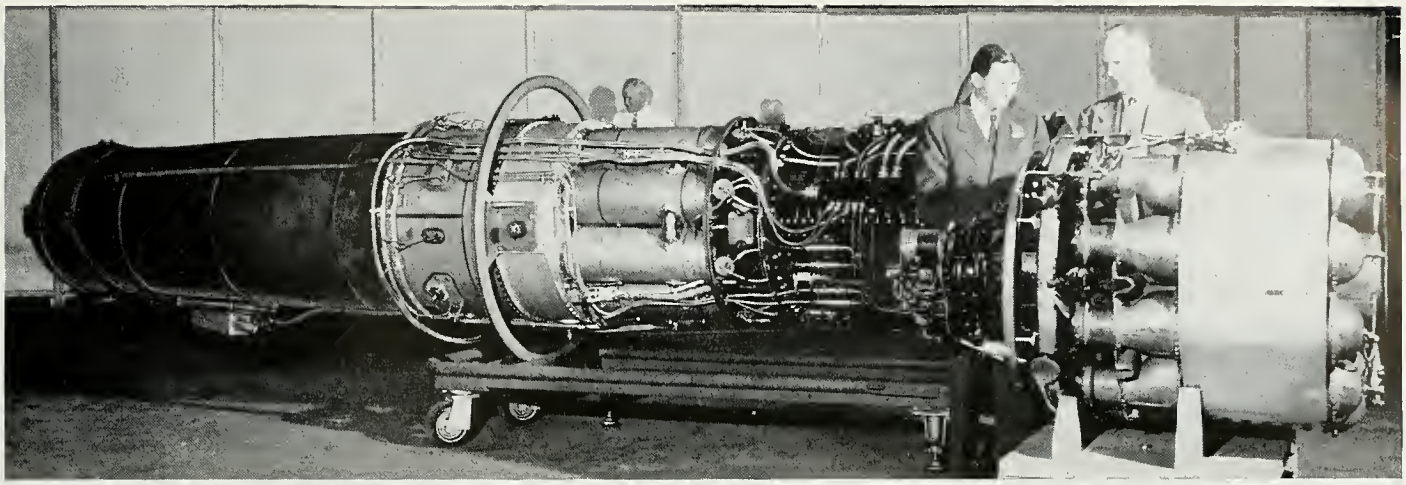
Since 1942, General Electric jet engines have flown more hours and set more records than all others combined

ON the tenth anniversary of the aircraft gas turbine industry in the United States this spring, General Electric delivered to the Air Force the 10,145th jet engine the company has produced.

"The next 10,000 engines will be produced in a fraction of the time taken for the first 10,000," says E. S. Thompson, manager of contracts for the G-E Aircraft Gas Turbine Division.

Included in the engines produced by G. E. during the past decade was America's first jet engine, the I-A, which initially ran on March 18, 1942, and which





J. W. Belanger, G-E vice-president (left) and C. W. LaPierre, Aircraft Gas Turbine Division manager, compare company's first jet engine, the I-A (right), with one of the latest power plants, the J-47-GE-17 (left), for which Ryan builds many "hot end" parts.

powered the first American jet airplane, the Bell P-59 Airacomet.

The 10,145 engines produced by G. E. also include such models as the I-16, which Ryan Aeronautical Company used in its famed FR-1 Fireball, the world's first jet-plus-propeller plane and the U. S. Navy's first jet aircraft. Other models include the J-33, J-35, and the J-47. Advanced designs of these later engines, which are many times more powerful than the I-A, included exhaust cones, combustion chambers and other "hot" components built by Ryan's Metal Products Division.

Planes powered by engines designed and produced by General Electric include the North American F-86 Sabre, holder of the world's speed record and now winning air battles in Korea; the six-jet Boeing B-47 Stratojet; Republic XF-91 interceptor; the North American B-45 Tornado, the Air Force's first operational jet bomber; the Convair B-36, which has four jets in addition to six piston engines, and the Martin XB-51 three jet bomber.

Some of the history of early development of jet engines in this country was recalled by Charles E. Wilson, former General Electric president, on the occasion of the tenth anniversary ceremonies held at the G. E. Lockland, Ohio, plant. "When we heard of the British progress in building a jet engine," Wilson said, "we were certain that our scientific and engineering staff—with its long experience in turbines and turbo-superchargers—could make an extremely valuable contribution.

"Through the instance of Dr. Vannevar Bush, then head of the Office of Scientific Research and Development, we arranged to consult with the British. Then, through General Hap Arnold, a

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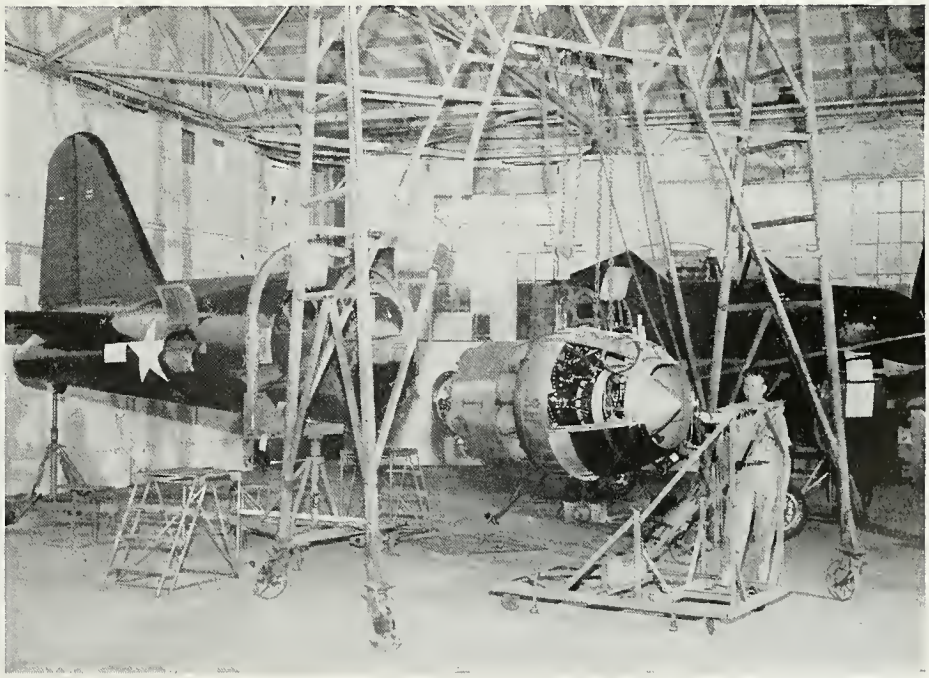
Evolution of a jet engine is depicted in this family of G-E power plants which span the I-A of 1942 and the most modern J-73. Engine thrust has multiplied more than five-fold in the progressive research underlying this development.



Ryan Fireball featured split fuselage to provide carrier crews with ready access to buried I-16 jet engine. Less than one hour was required to make complete engine change. Fireball was first jet plane to qualify for carrier flight.

Pratt & Whitney Wasp Major exhaust production speeded by special techniques

BALA

BY tailoring manufacturing methods to fit the parts, Ryan has raised volume, reduced space requirements and balanced production in the fabrication of exhaust systems for R-4360-59 Pratt and Whitney aircraft engines. Involving a major switch from conventional "batch" methods to a "flow" type of fabrication, the innovation has also improved parts quality and enhanced employee morale.

Sparked by the necessity for expanding Wasp Major "-59" quantities in limited factory space, Ryan production experts devised the new assembly arrangement, which is centralized in four contiguous areas. In each, machines and fixtures are placed in specific patterns to meet the flow of parts. Custom-made dollies, rolling on continuous floor tracks, carry the parts to the machines.

This is in sharp contrast to the former method where equipment had to be spread out to allow batches of parts to be carted to each machine. A forty percent saving in valuable floor space has been realized by grouping jigs and tools along the new tracked conveyer lines.

An important advantage of the system is the achievement of balanced control of both parts and production. The parts consist of seven large, tubular sections of stainless steel. Looking deceptively identical, each is actually different in design. All seven fit together to form a complete exhaust system for an engine of a Boeing C-97 Stratofreighter or KC-97 aerial tanker airplane. Since shipments are made in complete engine sets, it is high-

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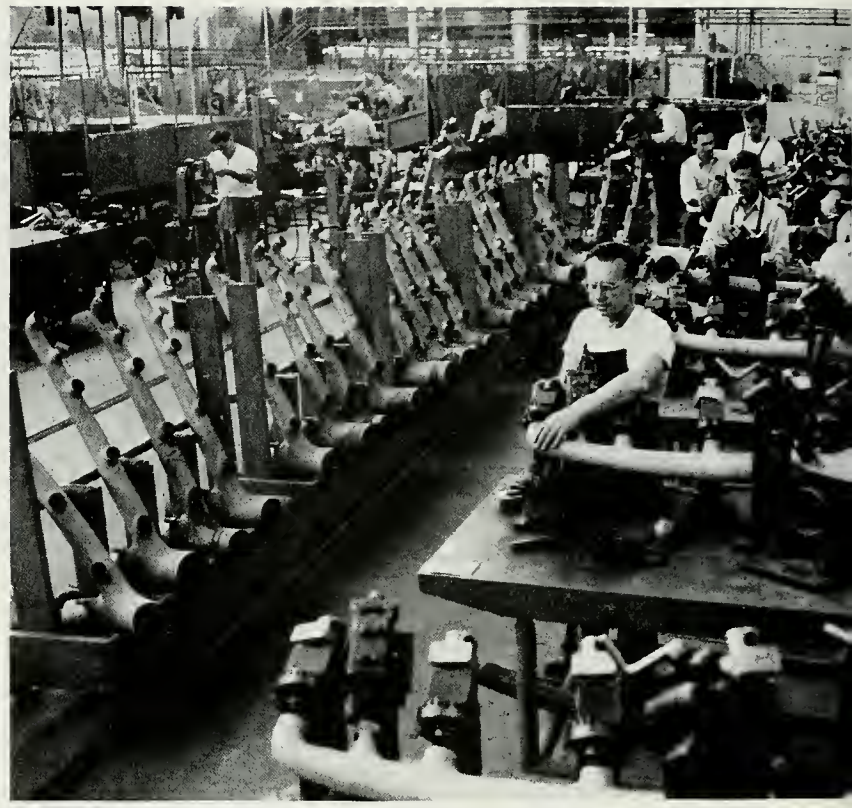
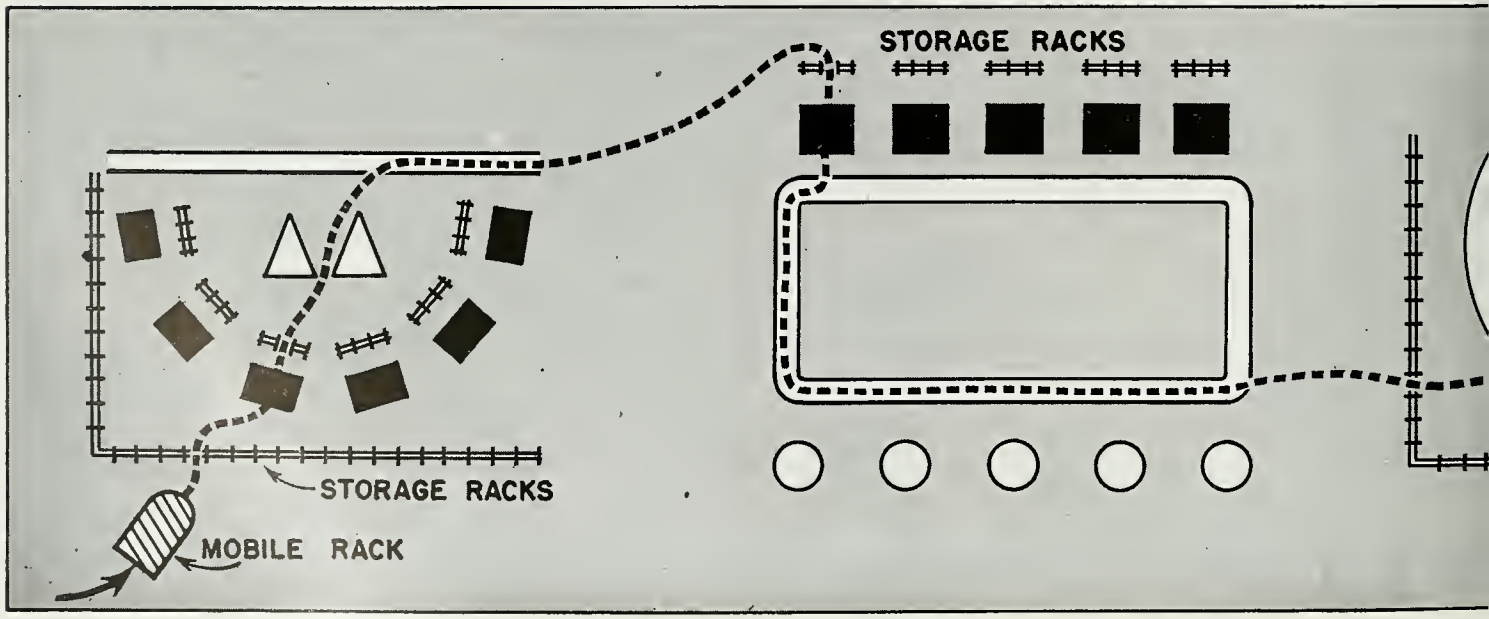
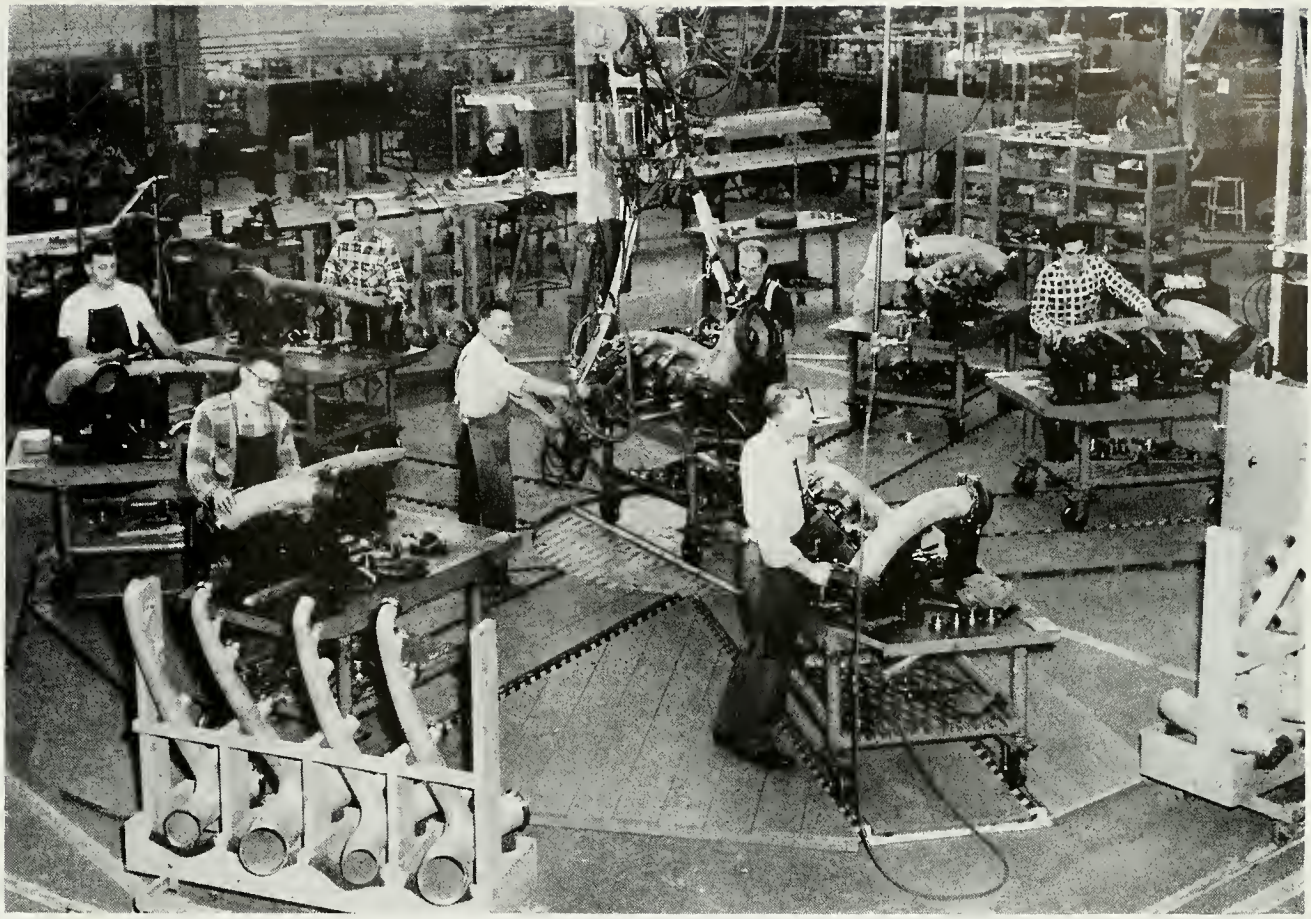


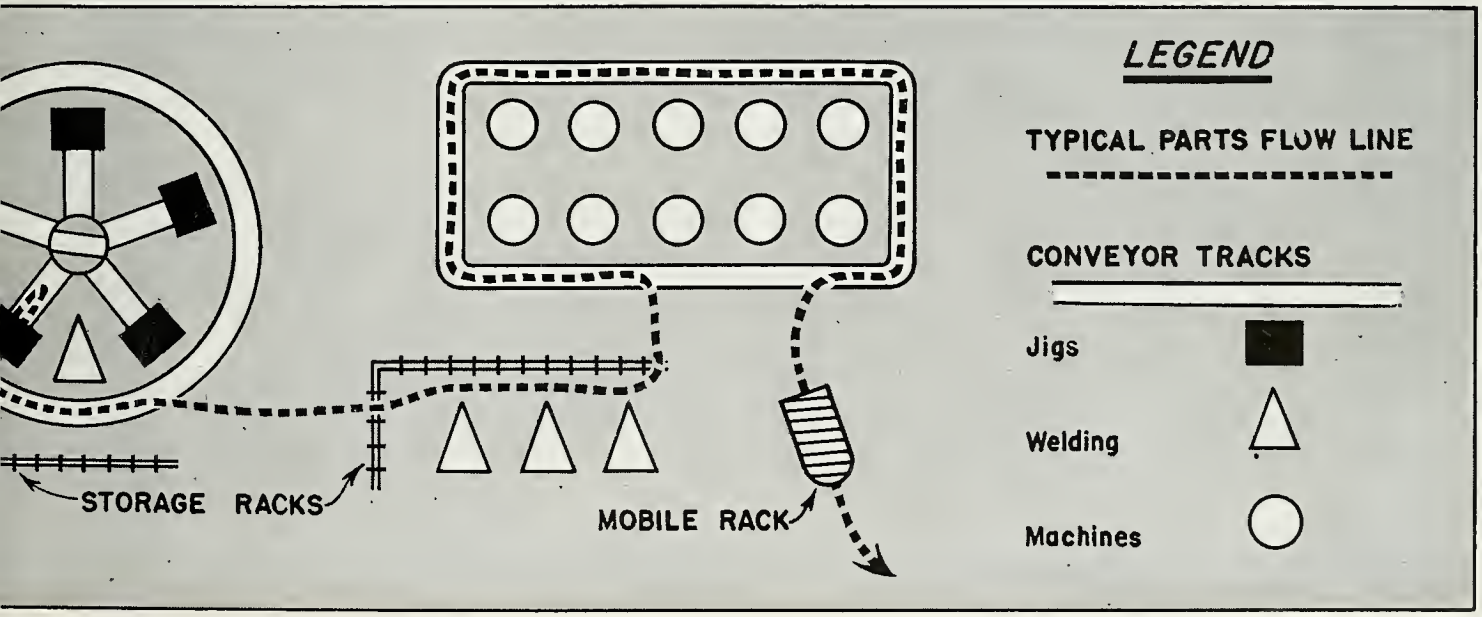
In second area, conveyor line circles inside of a precision jig line wher sections are carefully scribed for trimming, facing and other machining o

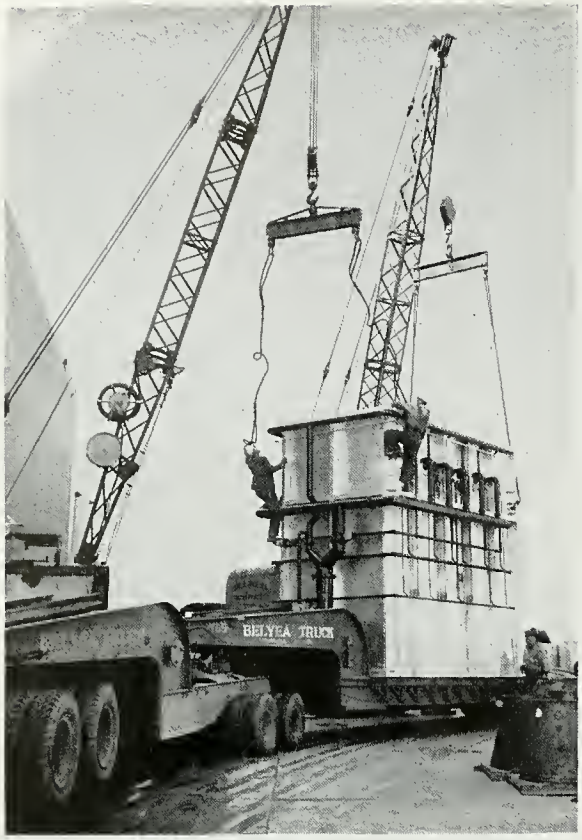




Heart of conveyor system is this turn-table in area three where jigs are moved on tracks to centrally-located welders.

NCED PRODUCTION





Thirty-two ton furnace, built in Los Angeles, arrives at Ryan far installation in new jet parts building.

NEW NEST OF JET POWER

One of the most up-to-date collections of machine tools under one roof in the aircraft industry is being rapidly installed in the new jet engine parts assembly building at Ryan Aeronautical Company.

The $300,000 structure, which has 75,000 square feet of floor space, will shelter more than $2,000,000 worth of new production machinery and other equipment needed for mass production of jet engine components.

From this building will pour an endless stream of combustion chambers, exhaust cones, tailpipes, exhaust nozzles, afterburners and other precision-built stainless steel components for jet engines.

Already one of the nation's leading users of electric resistance welding, Ryan will have an impressive array of such welding machines in long production lines.

Huge vertical turret lathes, a boring mill, a cone rolling machine, and two giant heat treat furnaces—one electric, the other gas—are among the facilities being installed. Even foreign machine tools of the latest design—two French radial drills—are in use.

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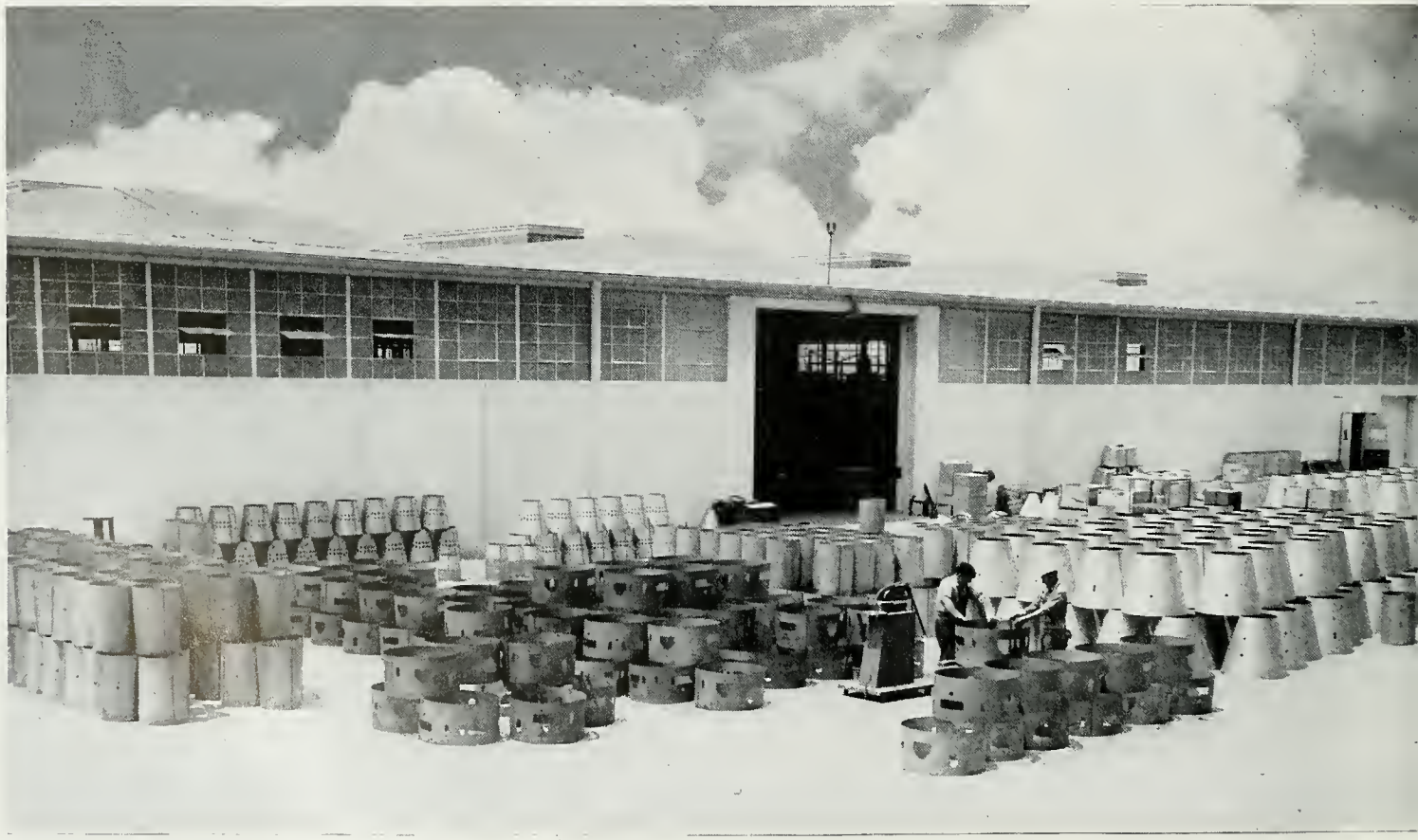
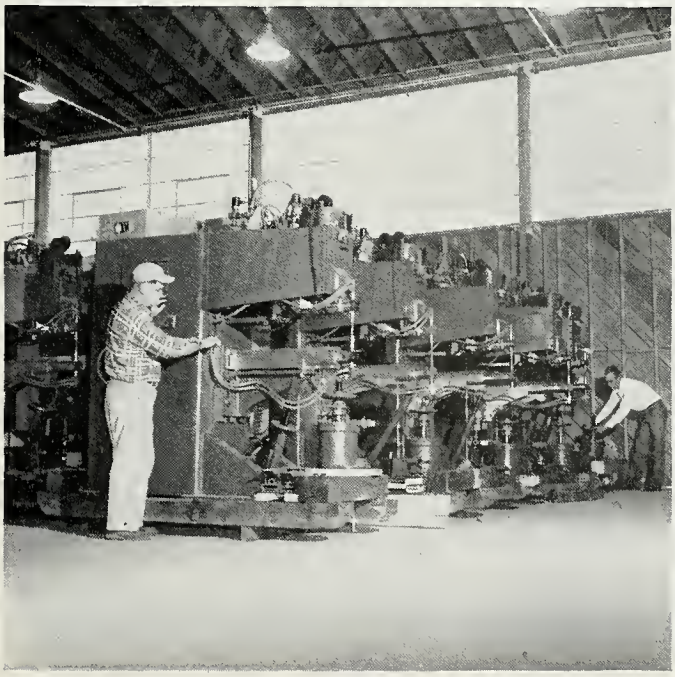
Exhaust cones, afterburner parts and tailpipes from main factory building are stored outside jet building, where they'll be assembled.

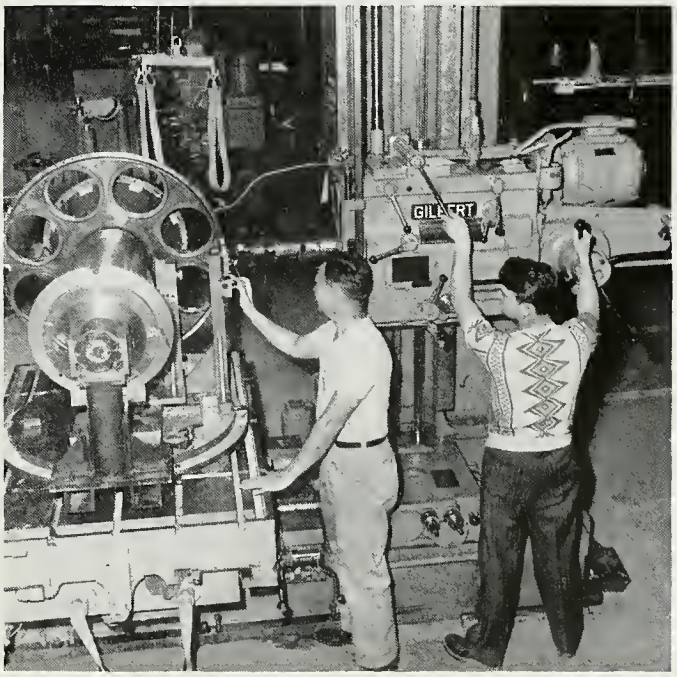


Jet engine aft frame flanges are machined on big Bullard lathe in new building where most modern equipment is being placed.

Battery of Taylor-Winfield spot welding machines is set up as preparations are rushed for mass output of jet engine parts.



New boring mill performs facing, drilling and tapping of the lifting bracket in aft frame of General Electric jet engine.



Ordered for installation in all Boeing 377 Stratocruiser airliners, Ryan ceramic coated exhaust headers are checked by Hugh Barkley.

Ceramics for Piston Engines

FOUR major airlines are flight testing Ryan ceramic coatings and special alloy exhaust systems in a unique, comprehensive test program. Pan American World Airways, United Air Lines, Northwest Airlines and British Overseas Airways Corporation are participating in these investigations which will reveal authentic data concerning the behavior of these materials under extended airline operation.

The test program has been arranged through the joint efforts of Ryan and Boeing Airplane Company and are being conducted on Boeing 377 Stratocruisers operated by the four airlines. The test sections are Ryan-built "headers" which channel the hot exhaust gases from the powerful R-4360 Pratt and Whitney 3500 horsepower engines of the Stratocruisers. As the hottest operating parts of these exhaust systems, the headers will provide the most tortuous test conditions for the Ryan ceramics and alloys being analyzed.

Because the parts are identical in design, and tested on similar aircraft of four airlines ranging throughout the world, an extensive fund of technical information will be obtained by the Ryan Development Laboratories. These reports will be used to continue to improve Ryan ceramic coatings and produce new designs for future high temperature exhaust equipment.

The first group of test headers were placed under test on Pan American Stratocruisers, of the Pacific Division, more than two years ago. These units are now approaching 2500 hours of flight test and have been examined in the Ryan Development Laboratories at regular intervals. At approximately 600, 1000, 1500 and 2000 hour periods the headers were removed, sent to Ryan for complete laboratory examination and returned to service.

A direct result of these evaluations has been the perfection of Ryan ceramic coatings and the order to equip all exhaust systems of Boeing 377 Stratocruisers with Ryan ceramic coated components. In addition, Ryan has received the largest orders in the industry for ceramic coated components for fleets of Convair Liners, Pratt and Whitney engines and Continental tank engines.

(Continued on page 23)

Ceramics for Jet Engines

RYAN ceramic coatings are being applied to jet engine components. Eminently successful in extending the service life of high temperature exhaust systems for piston engines, the thin protective coatings are being applied experimentally to combustion chambers and transition liners for General Electric J-47 jet power plants.

Under the direction of the Ryan Development Laboratories, these "hot end" components have been fabricated from stainless steel, type 321, ceramic coated and shipped to G-E's Lockland, Ohio, plant for evaluation. They are undergoing "hot" engine run tests with two objectives; to determine if the type 321 stainless steel-ceramic combination will stand up as well as standard parts made from Inconel and to observe the behavior of the Ryan ceramic coatings under the ravages of jet engine environment.

Added impetus for the investigations exists in the critical scarcity of nickel which comprises 70 percent of the Inconel alloy now used in the combustion chambers and transition liners of jet engines. If type 321 stainless steel, which contains only eight to eleven percent nickel, can be substituted for nickel-rich Inconel, a substantial saving of the white metal will be realized.

The thin coatings of Ryan ceramic have been applied to the stainless steel surfaces in order to protect them against rapid oxidation at flaming temperatures. With a lower resistance to high temperature oxidation than Inconel, type 321 stainless steel requires this surface treatment in order to withstand the intense ravages of life in a jet engine.

In three years of comprehensive flight testing, conducted by the Ryan Development Laboratories, it has been shown conclusively that the Ryan ceramic coatings have extended the service life of exhaust systems for piston engines in aircraft. The tightly-adherent coatings have resisted chemical and physical change normally occurring in the presence of flaming gases whose temperatures run as high as 1800°F. As a result of their stamina and tenacity, the metal exhaust systems have been protected against deterioration by oxidation, carbon absorption and corrosive attack. In this way, the coatings have added many hours of service life to these high temperature components.

It is interesting to note that service life conditions encountered in jet engine combustion chambers and transition liners are quite different from those found in exhaust components for reciprocating engines. In these jet engine parts, pulsating pressures, as well as withering temperatures, are prevalent to attack the ceramic coatings.

Tests are also being conducted with combustion chambers made of Rosslyn Metal. In this instance, the successful performance of this sandwich-type metal would not only save nickel but may improve thermal characteristics. With a one-third center slice of copper, Rosslyn Metal reduces the need for nickel, cobalt, tungsten and other short-supply metals by that amount. Because of its extremely good lateral conductivity of heat, highest of all heat-resisting materials, Rosslyn Metal may eliminate "hot spots," or accumulations of heat, in the walls of jet components.

Understudies for Inconel, these Ryan ceramic coated transition liners (top) and combustion chambers (bottom) are examined by Walter Phillips before going to G-E tests.

WONDER BOX for MILITARY NAVIONS

Summers Gyroscope uses their Navion as a Proving Ground for All-Weather Autopilot for Air Force

Navion, shown with Chief Pilot Al Hanes, is given rough use in testing Summers Gyroscope Company's new All-Weather Autopilot.

TWO Navions and a "wonder box" are teaming up to develop for the Air Force still another guide through fog and clouds shrouding airports.

The wizard gadget is the Summers All-Weather Autopilot, on which four years of research and development have been spent by the Summers Gyroscope Co., of Santa Monica, California.

Since early this year, more than 110 hours of rigorous flight tests have been made by Summers in their company-owned Navion, through all kinds of weather, to check the Autopilot's performance. And recently, a "wonder box" has been installed in an Air Force Ryan L-17 Navion at Wright-Patterson Air Base for further tests and evaluation, which will be conducted coincidentally with Summers' own program out of Clover Field, Santa Monica.

During an intensive four month period of flight tests, the Summers' Navion averaged two landings and two takeoffs per hour, besides constantly repeated simulated approaches in flight — treatment that strains an aircraft to the utmost.

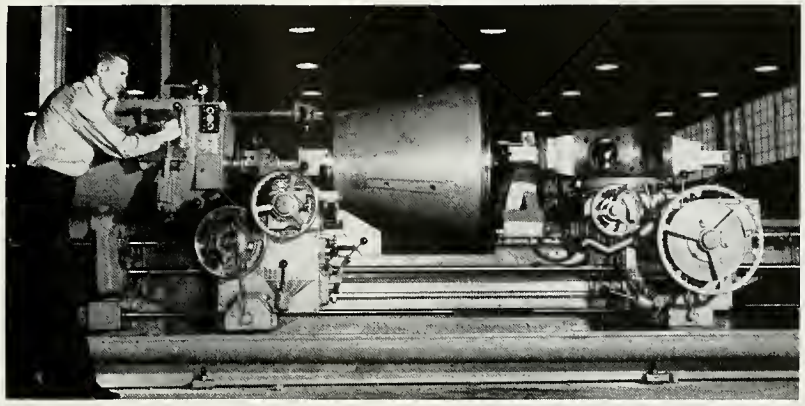
Says Al Hanes, Summers chief pilot: "The Navion is one of the most rugged and stable aircraft I've ever flown. We've flown test flights in all kinds of weather —rain, fog, hail and extreme turbulence —and the Navion has stood up better than I had thought possible. We've yet to cancel a test flight because of mechanical difficulties with our Navion."

The Navion has helped Summers demonstrate that with the All-Weather Autopilot, virtually all a qualified pilot need do on a landing approach in thick weather is maintain constant airspeed. The electronic brain will do the rest, bringing the craft down to within a few feet of the runway. Relatively inexperienced pilots, as well as military and commercial fliers, may soon be able to ride their planes down an instrument landing system (ILS) with no difficulty.

On entering the localizer area in an instrument approach, the pilot establishes

(Continued on page 19)

Handily located, pilot's compact control box for All-Weather Autopilot is placed at top center of Navion's flight panel.



Unique Lathe Speeds Cone Cutting

Ryan has markedly cut the time required to machine large jet engine exhaust cones with a new lathe —especially designed for the job. Built by Warner & Swasey, to meet Ryan requirements, the first of six of these unique gap lathes has been installed and is being operated by Harry Stanley (above).

With a single set-up, the time-saving tool machines the flanges at both ends of the big cones. Cutting tools turn and form the flanges to exact dimensions in one pass. These features give the lathe marked advantages over vertical turret lathes which require two set-ups and a tool change to accomplish the same result.

To produce the new machines, Warner & Swasey modified the design of their heavy-duty lathe in a major way to adapt them to Ryan jet engine production work. Special tools and tool holders were devised so that the cones could be machined from both ends.

With a Ryan-built arbor and trunnion and an electric hoist and swinging crane, one man can load and operate the machine.

Exceptionally high precision, as well as good production, is obtained from the lathe because of its sturdy construction. The base is a one-piece welded steel foundation with twice the stiffness of cast iron. V-bedways are induction-hardened to specific depth and hardness to minimize wear. Drive is from a 50-horsepower electric, two-speed motor with push-button control. All gears and shafts are of hardened and ground chrome-nickel steel and lubricated with cooled and filtered oil. An efficient hydraulic brake brings the spindle to a fast, smooth stop regardless of speed.

WONDER BOX

(Continued from page 18)

his airspeed at 90 to 100 miles per hour, depending on the air turbulence at the time, and maintains that speed with wheels and flaps down.

The Autopilot approach switch is thrown on when the needle pointer on the ILS Glideslope indicator points to the bull's-eye. From that point to actual touchdown, the pilot merely regulates his throttle to hold the desired air speed.

Here are the components of the Autopilot set into operation to bring the Navion in to visual reference of the runway, or within a few feet of the landing strip:

A Gyrovertical for controlling aircraft pitch and roll attitudes.

A Control Box for directing automatic functions of the equipment by switch control.

An Altitude Holder for holding the plane to a fixed altitude.

An Amplifier and Junction Box containing computing circuits, magnetic amplifiers and relays—this is the "thinking mechanism."

An Elevator Trim Tab Servo for setting trim at level flight position, climb and dive, or automatic approach to a landing.

Two Gyro Servos, one controlling the elevator and the other the ailerons.

All these devices are packaged into a "wonder box" weighing only 39 pounds which is designed to have a life span of some 1,000 operating hours. Magnetic amplifiers are used in place of vacuum tubes to improve reliability and longevity of the product.

By holding the Navion to a constant magnetic heading and altitude, directing it toward an ILS system through its localizer, and then riding the glide slope beam down to a landing, the Autopilot functions like a veteran airline pilot.

And the Ryan Navion, one of America's most versatile planes, with a record of trustworthiness in both military and civilian use all over the world, is performing a vital role in this new development to improve flying safety.

BLIMP BLANKET

(Continued from page 1)

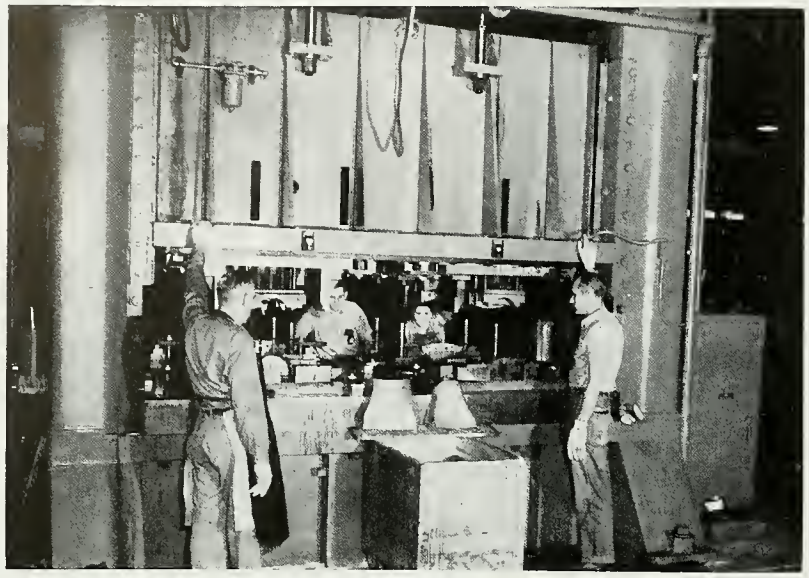
without a loss, many believed that blimps had passed their peak of usefulness and would be permanently relegated to moth-ball obscurity. However, recent developments in sonar and electronic means for detecting submarines, most of which are cloaked in secrecy, have given the lighter-than-air craft a new place in the arsenal of naval weapons.

Blimps can fly around the clock, landing on carrier decks twice daily to change crews and replenish fuel and stores. Or, they can re-fuel in mid-air from sea-going tankers. Capable of speeds far exceeding surface craft, coupled with their ability to hover motionless, these gas-filled observation posts are efficient search machines.

The general search weapons of the Navy's "hunter-killer" teams are ship-board sonar, underwater sound detection devices and airborne radar. Expendable sono buoys, which are usually dropped by planes, and magnetic airborne detection (MAD) gear, which is most effective on blimps, enable aircraft to pinpoint and track target submarines even when submerged.

Airborne radar can pick up the extended snorkel tube of a submarine and bring the "hunter-killer" team into action. If the submarine dives deep enough, visual and radar beams are no longer effective in determining where it is. Then, sono buoys can be dropped into the sea to divulge its position. These are small radio broadcasting sets, in metal containers, which drop a sensitive microphone into the water and extend a whip antenna above the surface. They can "hear" the sounds of a sub's propellers or engine and transmit that data.

If the submarine remains quiet, magnetic airborne detection (MAD) can be used to reveal its position. The blimp is invaluable in tracking and pinpointing the target until destroyers and planes arrive to make the "kill" with bombs, depth charges, torpedoes or hedgehogs.



FOUR IN ONE

Ryan has telescoped four steps into one operation in the fabrication of transition liners for jet engines. By placing four separate dies on the big bed of the recently-installed 600-ton Warco press, one complete transition liner shell is precision-trimmed and joggled with each press stroke.

The expedited method saves time, releases equipment and improves the quality of the parts. It is another example of how Ryan's new, big presses can be used to step up production with multiple die set-ups, as well as through the use of large dies.

Transition liners are irregularly-shaped ducts which channel flaming exhaust gases from the combustion chambers to the turbine wheel of a jet engine. Much like a Bazooka gun barrel, they give direction to the searing gases which charge through at 1200 miles per hour. Made of tough, heat-resistant Inconnel, they must be formed to extremely accurate dimensions to perform their function.

In the Warco set-up, two of the dies precision-trim the sides of both halves of the transition liner shell and form the off-set which is later used for the lap seam weld. The other two dies precision-trim the ends of the shells and pierce them with indexing holes. Then, the parts are given additional work, assembled and seam welded together with electric resistance welding machines.

Four operators feed the parts to the four dies and shift them, between press strokes, in a continuous sequence. Above photograph shows (from left) Walter Handel, Marvin Chapman, Fay Southward and Lewis Todd performing this work. The big Warco lends itself to this type of fabrication because it can exert the heavy pressures required and has multiple push-button controls which insure complete safety under these conditions.

FASTEST TEN YEARS IN HISTORY

(Continued from page 11)

model of one of the British engines designed and developed by Frank Whittle, the brilliant engineer of the Royal Air Force, was brought to the United States, and our real work began.

"We in this country profited greatly, in the development of this first jet engine, from the exchange of experience and ideas with Britain. And they profited greatly from our subsequent developments of their idea.

"In any observance of this kind, we would be remiss, indeed, if we did not pause to acknowledge our debt to the late Dr. Sanford Moss, whose long research and experiments led to the development of the first turbo-supercharger. He was our first pioneer of the turbo-jet age."

Arrangements were made to ship the necessary drawings and a sample "Whittle" engine to General Electric, which arrived at Lynn, Massachusetts, in October of 1941. In five months the first American version was operating on the test stand, and, within exactly one year, by October, 1942, a Bell P59A using two General Electric Type I turbo-superchargers (turbojets) made its first flight at Muroc Lake, California. A remarkable feat indeed!

NEW NEST OF JET POWER

(Continued from page 14)

So tall is the electric furnace, built by General Electric, that the roof had to be "raised" five feet at the northwest corner of the structure to accommodate it.

While one group of workmen has been uncrating and setting up the shiny new machinery, another group has been tackling the difficult problems encountered in production of the first few parts in contracts calling for many thousands. The latter group is racing against time, aiming at solution of the problems by the time the machine tools are ready to accelerate output.

MILLIONTHS FOR DEFENSE

(Continued from page 9)

Ryan fabricates, tolerances must be maintained within a few thousandths of an inch for long runs. Some assemblies are required to fit together with only .0001 inch clearance. Since a gauge should be at least ten times more accurate than the part it measures, this means that some instruments have to measure to a hundredth thousandth of an inch. To check these gauges, precision blocks must detect millionths of an inch discrepancies.

ACTUALLY, it is easier to measure a millionth of an inch today than it was to determine a thousandth in 1860 because of the great strides which have been made in this field. Also, a California inch is identical to an inch in Maine, or anywhere else, within a few millionths, because of the National Bureau of Standards control.

To find out where this standard began, you have to go back a century to the time when the French, disgusted with the indefinite English "foot," established the meter. Intended to be exactly one ten millionth of the distance between the Pole and Equator along a meridian, it was delineated by two scratches on a metal bar. Congress decreed the American inch to be one 39.37th part of the meter and a platinum-iridium meter bar has been nursed in an air-tight glass case in the Bureau of Standards ever since.

An interesting sidelight on this affair is the way in which modern measuring precision has obsoleted standards of measurement. For instance, the French cleverly simplified their systems of volume and weight by basing their liter and gram on the meter. They decreed that

(Continued on next page)

the liter would be the volume of a thousand grams of distilled water at 4°C. and the gram, the weight of distilled water at 4°C. contained in a cube whose edge was one hundredth of a meter. Now, however, it is found that the volume of a thousand grams of water at 4°C. is not exactly one hundredth of a cubic meter, but 1.000027 hundredth of a cubic meter. Only when it became possible to measure to a millionth was this fact discernible.

When Ryan precision gauge men need a flat surface on which to make a measurement, they turn to a 20-by 24-inch slab of granite which has been ground and lapped smooth within 5 millionths of an inch. Being stone, it has a very low coefficient of expansion and, therefore, is not appreciably distorted by temperature changes. However, care must be exercised when checking level indicators on it because one end of the slab drops .005 inches below the other every night when the tide goes out. This is due to the fact that the Ryan plant is built on filled ground, dredged from the bay, which shifts slightly with tidal movements.

At this moment, the final arbiter in determining accuracy is the length of a wave of light, which seems to be unvarying under all conditions. It is used to check the dimensions of precision gauge blocks.

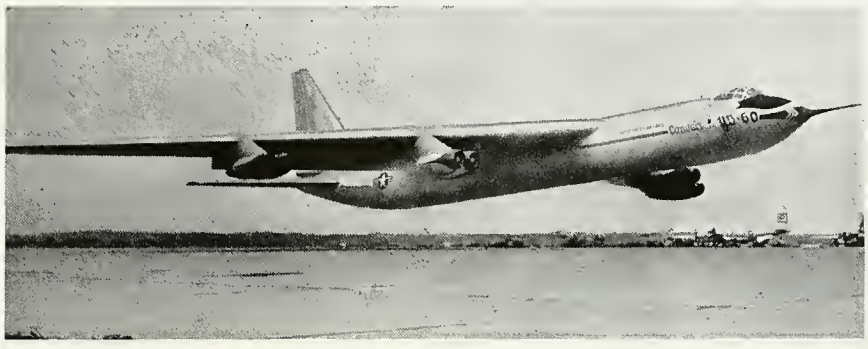
ONE method of using light waves as a ruler is in conjunction with an "optical flat." This is a disc of the finest quartz glass which is made by melting natural quartz crystals in an electric furnace into a clear, hard ingot. The highly transparent disc has an amazingly low coefficient of expansion of only .00000031 inch per inch per degree F. or approximately 1/3 of a millionth part.

The light source used is usually an incandescent helium-filled tube which emits a cool, single-color light. The absence of heat simplifies distortion problems and the use of a monochromatic light permits the observation of one light wave length. The optical flat is placed on top of the object whose flatness, parallelism or size is questioned. The light is projected through the disc and reflected back from the object.

As the beam reaches the bottom face of the disc, it splits, with part of the light being immediately reflected and another part going to the face of the object and being reflected from it. If the object face is not as flat as that of the optical flat, there will be a tiny wedge of space between the two contacting surfaces. When the light is reflected back from the object's surface, it will be slightly "out of step" with that light already reflected back from the disc edge, because it has had to travel back and forth over the distance of the air space.

Wherever the air space, or distance between the two objects, is one-half, or a multiple of one-half the wave length thick, the two returning beams will cancel each other and produce a dark band which can be seen with the naked eye. By simply counting the number of these "interference bands" over the surface, it is possible to tell, within a few millionths of an inch, the amounts of discrepancy present.

A better conception of this accomplishment can be obtained if you imagine that a millionth of an inch were represented by the thickness of one dime. Keeping the same proportion, it would take a stack of dimes four times as high as the Empire State Building to represent one inch.



"Hot Parts" Builders Watch "Hot" Planes' Progress

America's two mightiest bombers have launched flight testing programs being watched with intense interest by the "hot parts" builders at Ryan Aeronautical Company.

Convair's YB-60 (above) and Boeing's YB-52, both eight-jet giants, made their first hops within a few days of each other recently. Their power plants, the Pratt & Whitney J-57 engines, contain Ryan-built components designed to withstand extremely high temperatures. The J-57 is believed to be the most powerful engine of its kind in actual use.

The YB-52, on which production already has been ordered by the Air Force at Boeing's Seattle plant, has benefitted greatly from the experience of building and testing the world's fastest bomber, the smaller Boeing six-jet B-47, for which Ryan builds external wing fuel tanks and components for its General Electric J-47 engines.

The YB-52 is 153 feet long, with wingspan of 185 feet, and tail height of 48 feet. As in the YB-60, the wings also are sharply swept back. The landing gear consists of an unusual double-tandem arrangement composed of eight main wheels, with small protection wheels, supporting the wings, retracting into the wing tips.

The swept wings of Convair's bomber, which took off from Fort Worth, Tex., are 24 feet shorter than the 230 feet of the Convair B-36, of which the YB-60 is a development and improvement. The fuselage is 171 feet long, nine feet longer than the B-36, and tail height is 50 feet, compared with the B-36's 46 3/4 feet.

Although some of the dimensions of these giant bombers have been released, the Air Force is still keeping secret the weight and speed, range and other performance details.

Firestone officials viewed production techniques on rocket engines in recent visit to Ryan plant. Left to right, Bob Guyer, Ryan rocket assembly foreman; Leonard V. Firestone, Herbert H. Wiedenmann and Robert F. Kuntz, all of Firestone; Jack Zippwald, customer service superintendent (partially hidden), and Art Flakes, burring with a rotary tool on a motar assembly.

Firestone Views Ryan Rocket Engine Work

Leonard K. Firestone, president of the Firestone Tire and Rubber Company, and other executives of the Los Angeles firm who are concerned with production of a secret Army Ordnance guided missile, visited the Ryan Aeronautical Company recently.

Ryan, a leading manufacturer of rocket motors and jet engine components, is now in production of complete rocket engines for the surface-to-surface missile Firestone is building. The conferences and plant inspection at Ryan concerned manufacturing progress and technical aspects of the rocket motor project.

Last fall Ryan announced a ten-fold increase in production of rocket motors of tremendous power. At that time the company disclosed its contract from Firestone as an extension of previous production work done for Douglas Aircraft Company which worked on the original design of the missile with the Jet Propulsion Laboratory of Caltech.

The Firestone executives studied new techniques Ryan has developed in forming heavy-gauge metals to confine the tremendous but short-lived thrust of the engine, which creates terrific internal pressures while consuming vast quantities of fuel and oxidizer.

T. Claude Ryan headed the group of Ryan officials who conferred with Firestone and with Robert F. Kuntz, manager of the missile division; Herbert H. Wiedenman, plant manager, and Wynne B. Mullin, purchasing agent, of the Firestone Company.

BALANCED PRODUCTION

(Continued from page 12)

ly desirable to obtain a balanced flow of parts from production lines.

With high production, this would have been difficult under the former batch system because of the similarity of parts. Large numbers of indistinguishable components would have been shuttling between machines in confusing array. Only a time-consuming segregation and count would have disclosed the relative numbers of each part in production. With the new system, it is possible at all times to observe the progress of the parts and the exact numbers in each area. Adding to this facility is the fact that all dollies and racks are keyed to specific fixtures and designed to hold a normal day's work.

A SALIENT feature of the new program is the more efficient use of manpower and machines which it permits. In each area roving crews can be used to perform specialized tasks, such as welding. These crews go from one fixture to another, performing identical types of work on slightly different parts. They are followed by others who perform other specialized jobs. In this way, employees become specialists in skilled tasks and are not required to perform all types of work at a fixed location. This would not be possible if the work were not laid out along distinct, chronological lines of progress.

The system can be geared to varied rates of production. Of course, maximum efficiency is attained under optimum parts volume. Every machine is spotted in sequence at the exact location where the work is performed. Both the numbers of employees and machines can be balanced to fit the time required for each type of fabrication and the volume of parts to be processed.

Parts quality has been improved, due to two factors. First, a greater specialization of labor has been attained, which produces finer workmanship. Second, the parts are conveyed in specially-contoured, padded dollies instead of bare wooden boxes. More parts can be moved in a conveyer and they are properly separated so that damage from jostling together is eliminated.

Corrections of defective workmanship are handled with dispatch. Because the assembly is set up in a sequence pattern, each employee's contribution is readily apparent to the next person in the chain. In case of an error, it is merely necessary to return the part to the preceding station, instead of perhaps laying it aside until it can retrace its path to a distant and obscure machine.

Employee morale is stimulated by these factors. The employees are benefitted physically and mentally. Fatigue is lessened because the large parts do not have to be constantly loaded and unloaded from awkward boxes. Work flows in a logical stream which is not confusing to personnel. Better planning is possible so that delays and idle time are avoided. Mistakes and defective parts are minimized, raising standards of performance.

In many ways, the -59 exhaust parts are unique. They are the largest single-piece components used in aircraft exhaust systems and the first in which both header and collector sections are formed as integral units. A Pratt and Whitney Aircraft design, they require a variety of precise machine operations. To obtain efficient machine groupings, Ryan decided to establish the facilities in four centralized areas, served by tracked conveyer systems.

AFTER the tubular exhaust sections have been formed and seam welded, they are loaded into racks adjoining the first area. Here, they are carefully fitted with hangers and brackets. Roving crews feed the parts from seven jigs which fan into a central welding circle.

In area two, the parts flow through a series of machines which trim, face, burr, sandblast and size them with prescribed exactness. The conveyer lines circle within the machines to provide best access.

Area three is an interesting pattern of seven steel jigs which are on wheels and tracks converging into a central turn-

table, or merry-go-round. Port and outlet flanges are located and the jigs are rolled onto the turn-table. It is rotated so that an overhead, twin-gun machine can spot weld each flange in place. Conveyer tracks circle outside so that the jigs can be rolled to the turn-table.

From area three, the parts go to seam welding machines where the flanges are permanently welded on. Thence, they are taken to area four where they receive another series of machine operations. These involve a submerged pressure test, installation of hanger bushings and reaming of bushings and brackets. Special finned joint seats are attached to support an ingenious capsule-type joint which isolates the exhaust system from engine vibration and provides thermal expansion accommodation. After final alignment and inspection, the completed parts are placed in mobile racks and sent to the shipping department.

Surveys Secret Work

A technical survey of advanced secret Ryan projects was made in the plant recently by Charles L. Blake, left, aerodynamicist of the Research and Development Board, Washington, D.C., an agency coordinating the military's work on the frontiers of science. He is shown conferring with William T. Immenschuh, center, executive engineer, and Bruce Smith, right, engineering director.

WHY DID IT HAPPEN HERE?

(Continued from Front Cover)

had never before been given a thorough trial because the traditions of Europe did not lend themselves to the idea of personal liberty and private property for everyone willing and able to work for it.

But in America the circumstances were perfect for the full flowering of this revolutionary idea that the state was the people's servant instead of their master and that what a man produced was his to have and to hold safe from seizure.

The result was the greatest explosion of human energy known to history—an amazing demonstration of voluntary cooperation between free men.

The wise men of Europe who had predicted failure could scarcely believe their eyes.

III

But that explosion of human energy was only the beginning.

Something else had occurred in the world: the invention of the steam engine, which substituted mechanical energy for muscular energy.

This created the possibility of adding millions of mechanical slaves to the work force—workers who never got tired and did not compete with live workers for food, clothing, and shelter.

The steam engine did not mean much to the people of most parts of the world because their political and economic systems did not encourage the accumulation of private property through personal thrift and enterprise.

(In fact, even today most parts of the world have never caught up with the machine age, largely because there is no security for private property in the law and customs of the lands.)

But for America the steam engine was the crowning blessing.

Americans were willing to make the sacrifices and the savings needed to buy this new tool because they knew that they were investing in their own future, that it would not be taken from them by government or by brigands.

And the fact that private property was safe in America, made many Europeans eager to loan some of the needed money.

The power tool "population" kept growing until today *more than 95% of all work in America is done by machinery.*

IV

That machinery is the *mechanical* reason for America's strength and prosperity.

It explains why almost every able-bodied American can have a good house, an auto, a refrigerator, inside plumbing, a television set, a savings account, and a life insurance policy.

It explains why we produce as much as the rest of the world put together and do it on a 40 hour work week and with about 125 days of leisure in every year.

But we must always remember that it was the IDEA of personal freedom and protection of private property that made the machinery possible.

And we must also remember that we can lose the machinery by losing the IDEA.

For this reason we should be sure that we understand exactly what the IDEA is.

***First:* The institution of private property was recognized as the keystone of the free citizen because without private property the citizen is at the mercy of the State.**

***Second:* It is the right of any citizen to engage in any legal business of his choice.**

***Third:* It is the right of unusually capable people to earn unusually large incomes.**

***Fourth:* It is the right of every business manager to conduct his enterprise free from monopolistic restraints on the part of anyone.**

***Fifth:* It is the right of every worker to accept or refuse employment according to his personal desires and preferences.**

***Sixth:* Government tax policy must respect the right of every business to preserve its working capital and earn a fair reward for the people whose savings make up that capital.**

***Seventh:* The customers shall be the supreme authority as to which businesses fail or succeed and exercise this authority by freedom of choice in their purchases.**

This is the IDEA that brought us our magnificent stock of tools.

If we lose the IDEA, we will soon lose the tools.

CERAMICS FOR PISTON ENGINES

(Continued from page 16)

Some months ago, Ryan fabricated groups of test headers, similar to those on test with Pan American, and shipped them to United Air Lines, Northwest Airlines and British Overseas Airways Corporation for evaluation. It was felt that such a test, subjecting the parts to different airline maintenance methods and operating frequencies would be beneficial. For instance, Northwest Airlines employs their Stratocruisers in shorter flights, with more take-offs and landings per flight hours, than Pan American. BOAC methods of maintenance are somewhat different than those used by United Air Lines.

Each group of test headers consists of twelve sections of identical design but different materials. The design is the standard configuration which Ryan designed to Boeing specifications for the Stratocruiser. Headers are both coated with Ryan ceramic and uncoated. The special alloys used, some of which have not heretofore been subjected to this application, include 19-9DL stainless steel, modified 310 stainless steel, 310 with Columbium added, Inconel X, Haynes Stellite N-155, Armco 17-14 CuMo and Hastelloy C.

As in the case of the Pan American tests, these headers will also be removed and returned to the Ryan Development Laboratories for complete examination at periodic intervals corresponding to engine overhaul periods. At the conclusions of the complete test program, the information will be correlated and interpreted in a Ryan report which will be presented to key power plant and service engineering personnel from Boeing Aircraft Company and the four airlines. Representatives from the participating companies will be invited to meet at the Ryan plant to discuss these important findings. The companies which produce the special alloys used in the tests will be made aware of the information which appears to be useful to their field of interest.

RYAN GETS NEW AEROJET CONTRACT FOR MISSILE MOTOR COMPONENTS

A contract for production of missile motor components for an engine recently developed by Aerojet Engineering Corp., has been awarded by Aerojet to Ryan Aeronautical Company, specialists in the fabrication of high-temperature metals, T. Claude Ryan, president of the latter firm, announced recently.

Following other orders for missile motors, this latest contract establishes Ryan's position in the rocket engine field on a firm basis comparable to that it has already established in the jet engine and piston engine fields for production of heat-resistant components.

This is the second Aerojet rocket project for which Ryan has been selected as a production source. Previously Ryan built major components of the Aerobee high-altitude sounding rocket.

Currently, Ryan is also building complete rocket motors for surface-to-surface missiles under a production contract from Firestone Tire and Rubber Co. Ryan also supplied this same rocket motor under previous experimental contracts to Douglas Aircraft Company. The motor was developed by the Jet Propulsion Laboratory of the California Institute of Technology.

37 96

TWIN-NAVION

Ryanites did a "double-take" recently when they saw a twin-engined Navion land at Lindbergh Field and taxi up to the Navion service hangar.

Their eyes weren't fooling them. It was a regulation Navion which had been converted into a twin-engined plane by the Acme Aircraft Co. of Torrance for the Dauby Equipment Co., an engineering firm which is considering the possibility of modifying other Navions if tests with the pioneering job prove successful.

The Navion's original 205 h.p. engine was removed from the nose and replaced with 130 h.p. Lycoming engines on each wing. The wing areas were reinforced to support additional torque, and the fin and rudder area was increased to insure proper control. The engine nacelles are of full monocoque design.

Performance for the converted model, reported by Western Aviation magazine, gives it a high speed of 168 miles per hour in level flight at 5,000 feet altitude and cruising speed of 150 m.p.h. at the same altitude and 75 percent of power. Landing speed is practically unchanged, at 55 m.p.h., and maximum range is quoted as equal to that of the 260 h.p. version.

Roger Keeney, left, head of Acme Aircraft, flew to San Diego with C. J. Daubenberger, center, vice president of the Dauby Equipment Co., to obtain parts for the plane, which was tried out by Pete Girard, right, Ryan aerodynamicist. Other Ryan officials examined the unusual plane thoroughly on the ground.

POWER PACK FOR THE C-97

(Continued from page 7)

power package. Designed to give maximum access to all parts of the assembly, it saves manpower and prevents damage to accessories.

At Rohr factory, this impressive line of completed power packs for the C-97 is ready for shipment to Boeing factory at Seattle. With unsurpassed versatility, the big C-97 can be used as a flying fuel tanker, hospital ship, command post or troop carrier in addition to its cargo-carrying utility.

Last step in the process before the C-97 power packs are shipped to Boeing is the encasement of the complete package in a streamlined nacelle capsule which becomes a part of the Stratofreighter's wing.

Ryan builds two types of exhaust systems and associated equipment for the C-97 power plants. For a number of years, a Ryan-designed system, with Boeing modifications, has been supplied under contract to Rohr for the power packs. This design consists of seven individual header sections, each of which serves four cylinders. The headers are rigidly attached to the cylinder ports and special slip joints, between headers and collector ring, permit flexibility for thermal expansion.

From the collector ring, the hot gases are channeled through a tail pipe, which is attached by means of a 10-inch Ryan ball-and-socket joint. Incorporated in the Ryan tail pipe assembly is a waste-gate valve and turbosupercharger take-off.

THE other type of Ryan-built exhaust system for the C-97 is an integral collector design which has been perfected by Pratt & Whitney for their -59 model Wasp Major engine. With collector and header sections formed in single pieces, flexibility is attained in this equipment by means of unique capsule joints telescoped between the header ports and engine cylinders. Elsewhere in this issue, the system by which Ryan attains volume production on this unusual manifold is explained in detail.

Ryan ships these integral -59 exhaust systems to Pratt & Whitney who assemble them with the Wasp Major engines before sending the power plants to Rohr. The additional exhaust system parts — tail pipes, waste-gates and turbosupercharger equipment — which are not furnished by Pratt & Whitney with this engine assembly, are delivered by Ryan directly to Rohr for use in building up the complete power packs.

In addition to these deliveries, spare

(Continued on page 25)

POWER PACK FOR THE C-97

(Continued from page 24)

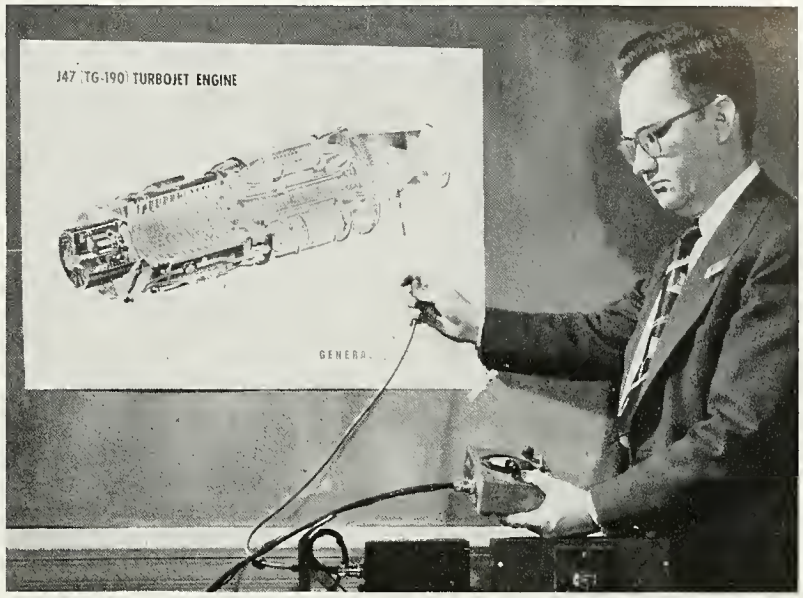
exhaust systems of the Ryan-Boeing design are shipped by Ryan to Boeing who supply them to the Air Force for the C-97's in military use throughout the world. Since these spares are replacement parts, rather than sub-assemblies of new power packs, they go direct to Boeing in response to Air Force contracts.

The third member of the C-97 power package team is the famous Pratt & Whitney R-4360 engine. Now capable of developing 3800 horsepower, the Wasp Major has more power than a diesel locomotive. Within the maze of its 11,000 finely-made parts, it burns fuel at the rate of 658 explosions per second. Four of these mighty power plants account for the C-97's 375-mile-per-hour speed.

Power packaging has grown into a successful business because it fills a need. Few people realize the vast number of parts which must be obtained and installed in a high-powered engine to equip it for service with an airplane.

The typical "power-package" consists of an airplane engine, furnished by the Government or the airframe manufacturer, around which Rohr has assembled and installed various Rohr-manufactured and purchased items, such as the motor mount, sheet metal cowling, diaphragm, panels, supporting structure, fuel and oil lines, electrical harness assemblies, various air ducting and a multitude of other items necessary for the engine's operation. For example, some of the power packages now manufactured require more than 3300 Rohr-made parts.

By specializing in this field, Rohr has relieved the airframe manufacturer from the necessity of loading his manpower with these problems and stocking and handling a multitude of engine accessory parts.



CURVED SEARCHLIGHT

37 96

General Electric has designed a new laboratory instrument which "peeks" into the flaming heart of jet engines and flashes its "observations" through a curved light beam. Known as a flame detector, the unique device reveals combustion data from hidden and inaccessible areas not heretofore explored.

G-E engineers, like C. R. Droms, pictured above, are using the flame detector to study tailcones for the J-47 jet engine. Fabricated by Ryan and shipped to G-E in large quantities, these assemblies are examined for flame and gas behavior.

The instrument consists of a four-foot length of fused quartz sheathed in a flexible stainless steel tube. The quartz is drawn down to a diameter of only three and one half times that of a human hair, to give it maximum pliability. The metal tube both protects the fragile filament and prevents light from entering it except at the exposed extremity.

Prior to starting the jet engine, the exposed tip of the quartz filament is located in the tailcone area to be checked. With the engine running, this "probing finger" collects visible light waves from the flaming gases and transmits them through the winding filament. The quartz has good light-conducting properties, even when bent and twisted. This light is conducted to a photo-tube which transforms it into electric current suitable for actuating an indicating instrument.

G-E engineers and designers confidently expect the use of the instrument will facilitate research work of new gas turbines designed for in improving combustion efficiency aircraft.

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RYAN BUILDING B-47 FUEL TANKS

(Continued from page 2)

squeeze aluminum alloy sheets together with 10,000 pounds pressure, and can produce more than 200 spot welds per minute, cramming nine of them into a running inch.

Because of the difficulty of cleaning the metal, an alloy of aluminum without cladding, Ryan had to develop a new cleaning agent, RACO 34, which removes all oxides with smooth uniformity.

Deliveries of the new B-47B Stratojets are being made in increasing numbers to the Air Force's Strategic Air Command. They are the first large planes to utilize sharply swept back wings and tail surfaces. Besides the six turbojet engines, 18 integral rocket-assist units are mounted in the rear fuselage, providing an additional 20,000 pounds of thrust.

Only three men are needed to operate the B-47B, which weighs almost 93 tons when fully loaded for combat. An experimental XB-47, with less powerful J-35 engines, still holds the transcontinental speed record, set in 1949, when it flew from Moses Lake, Wash. to Washington, D. C., 2,289 miles non-stop in 3 hours, 46 minutes, an average speed of 607 miles an hour.

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Ryan REPORTER

VOL. 13, NO. 5

WORKERS SHOULD HAVE CHOICE

by Maurice R. Franks

For the eleven years prior to 1947, Maurice R. Franks was National Business Agent of the Railroad Yardmasters of North America, Inc., and editor of the "Railroad Workers' Journal," the official publication of that union. He resigned this job to join with others in organizing the National Labor-Management Foundation, of which he became and still is President.

In a letter recently received from a labor union official, among other things, he took me to task for having editorialized against the "Union Shop." In part, he had this to say:

> *". . . It has been my observation that no one gets on a train without paying their way. The Union has been a gravy train for a lot of people who like to enjoy the benefits but do not like to pay their dues. If the benefits obtained by the Union were applicable only to their membership, there would be no need for a Union Ship, because the non-members would soon be in. . . ."*

Space permits only my quoting a part of my letter of reply to this gentleman. It follows:

"The better part of 30 years of my life has been spent in the union labor movement. This has given me ample opportunity to judge of the many and positive accomplishments of organized labor. I have seen for myself how the unions have worked to improve conditions for the workingman. I have witnessed first hand their crusades against child labor, sweat shops and kindred industrial evils.

"But indeed I do oppose the Union Shop that is being promoted by many of our present-day labor leaders. I oppose it as a coercive device which insults the essential dignity of man and ignores his inherent human rights as defined and safeguarded by the Constitution of the United States.

"No union as I see it, should be allowed to come between an individual worker and his right to earn a living. Compulsory unionism, in my book, is tyranny and should be treated as all other forms of tyranny have been treated by our people in the past.

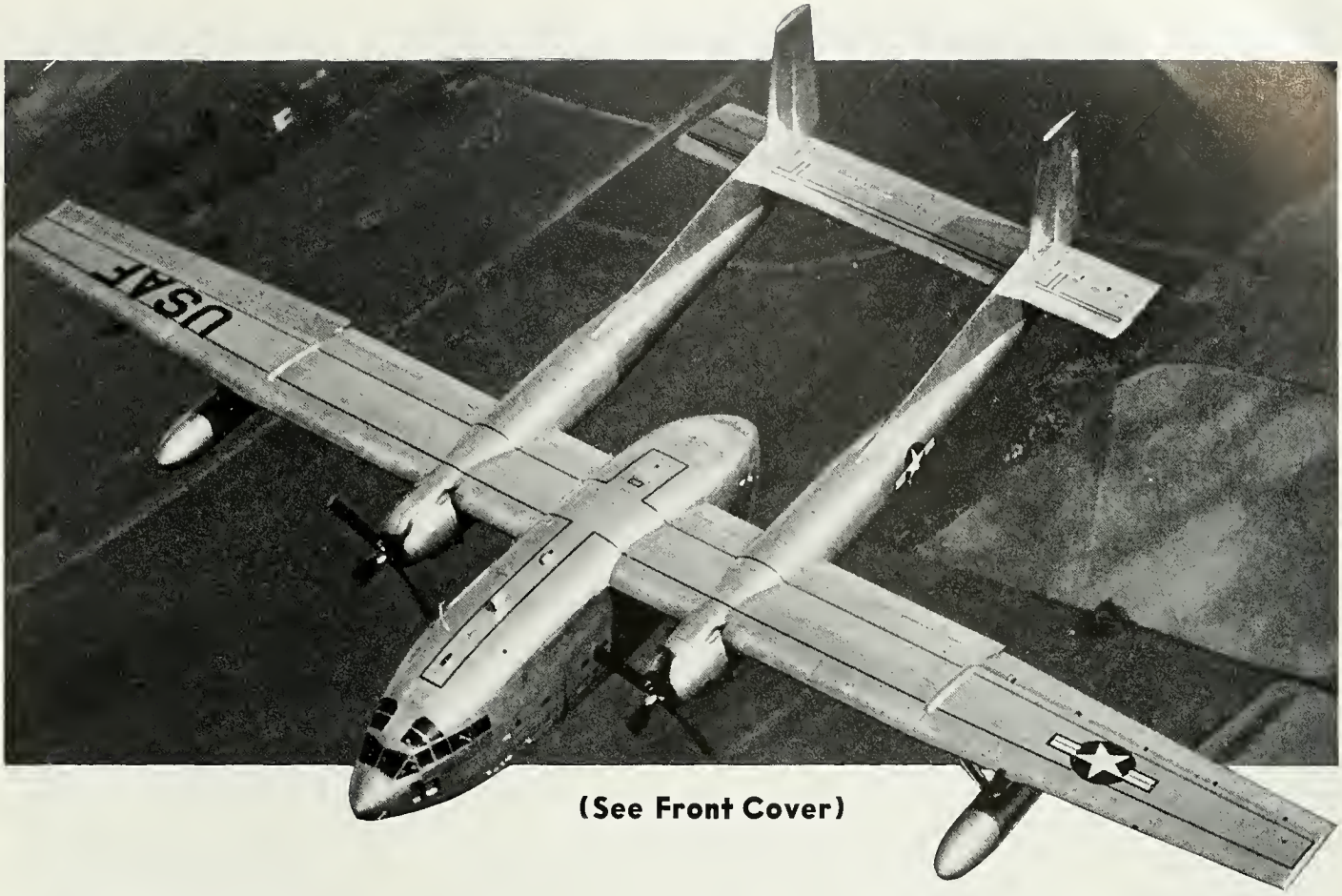
"Finally, I am against the Union Shop because I believe that unionism can be—*and should be*—sold on its own merits.

"The Union Shop, to my mind, means the setting up of a system that establishes the worker as the slave of the labor leader. It means monopoly—not one following the design of the Beef Trust as carried on by invested capital during the 90's, but one which is far more vicious. For the Union Shop means a monopoly of living human flesh. It means that the worker is to be controlled and bartered according to the whims of a monopolistic union leader.

"The Union Shop destroys the freedom of the workingman—the union man, if you please — and makes him dependent upon standing in good favor with the union bosses. If ever he gets in Dutch with the monopolists who rule his union, he can be deprived of his union membership, and being deprived thereof, he automatically loses his job—his right to earn a living.

"How a man in your position can uphold such a slave-labor device is beyond my comprehension. My own experience in the labor

(Continued on page 24)



(See Front Cover)

FUEL On The WING

Most striking innovation in new C-119H is the packaging of all fuel in Ryan tanks rigidly affixed to wings. Arrangement saves 600 lbs., cuts hazards and maintenance.

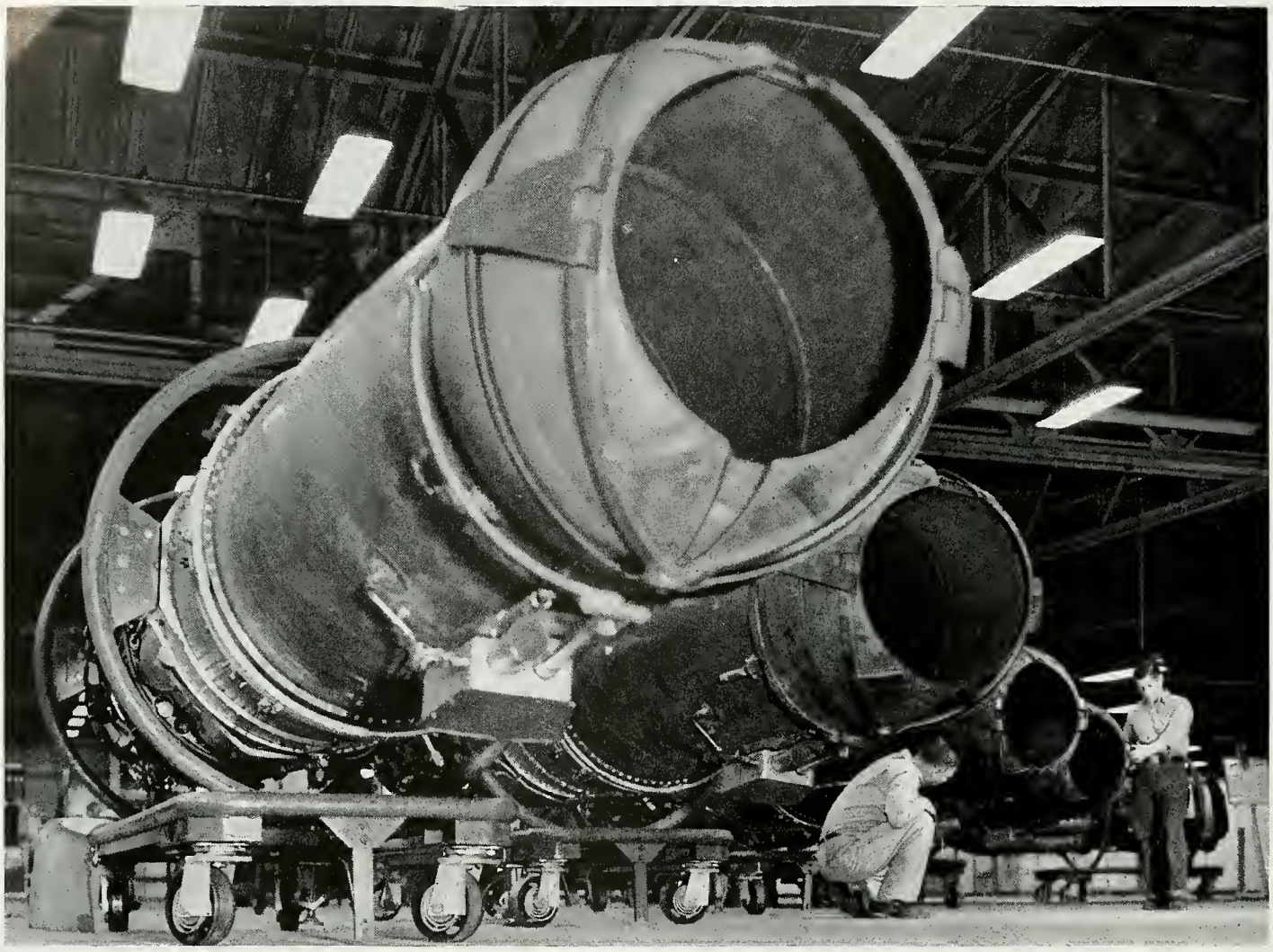
THERE'S a "new look" in cargo-transport planes.

It's exemplified in the Air Force's newest "Flying Boxcar," the Fairchild C-119H, distinguished by the appearance of two external fuel tanks permanently suspended beneath the wing outboard of the engines.

These tanks, largest ever built for aircraft, are products of Ryan Aeronautical Company, and are similar to the tanks which are being supplied by Ryan in mass quantities to Boeing Airplane Company for use in the B-47B Stratojet, world's fastest jet bomber.

In contrast with the B-47 tanks, which provide a supplemental supply of fuel and can be dropped when the gasoline is expended, the Fairchild C-119H tanks are an integral fixture of the plane. They represent a new concept of fuel storage in modern aircraft—a completely external system en-

(Continued on page 18)



Looking like gas-belching bazookas, afterburners of type Ryan builds are being prepared for final testing at General Electric plant.

JET HOT ROD

To illustrate the tremendous power required to push planes at supersonic speeds, the NACA Laboratory fabricated this model showing a hypothetical airplane designed to fly at 1350 mph. Note the huge power plant nacelles necessary to house turbo-jet engines with thrust sufficient to provide these high speeds.

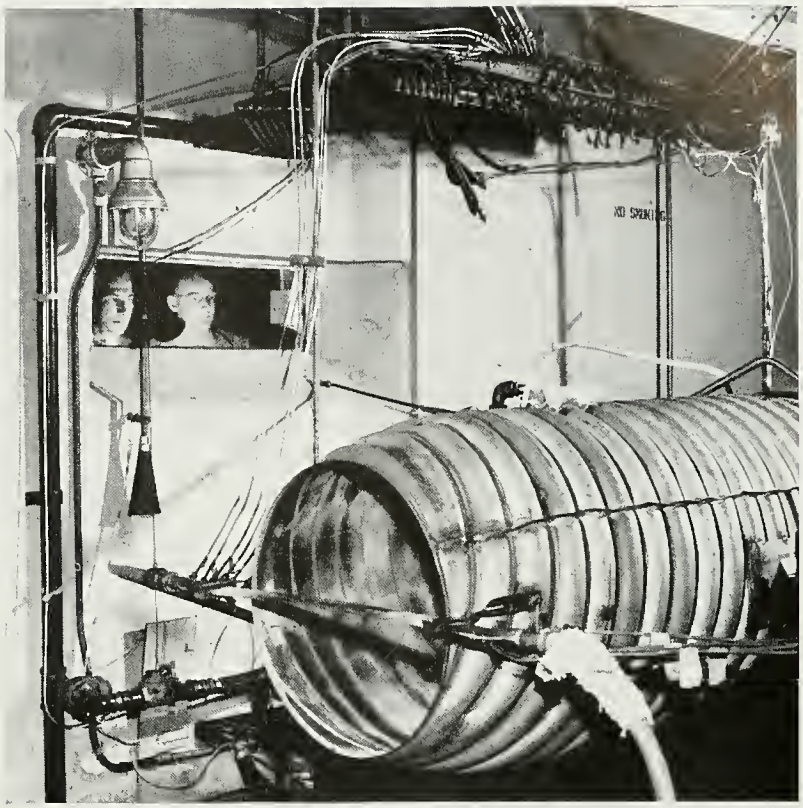
In this NACA model, also designed to fly at 1350 mph, note that the engine nacelles can be greatly reduced in relative size because the engines are now equipped with afterburners. Without these thrust-augmenting devices, the unwieldly size of the turbojet engines would render this design worthless.

FOR generating sheer power, with the simplicity of an exploding bomb, it's hard to beat an afterburner. From a tube no bigger than an elongated barrel are released energies which can virtually double the thrust of the most powerful jet engine. With a ground-shaking rumble, the afterburner instantly transforms fuel into thrust for flight. It consumes fuel like a flaming oil well but shuns all major moving parts and weighs only one-fourth as much as a turbojet.

Ryan has long been interested in the field of thrust augmentation. In connection with the Ryan XF2R-2 fighter—an advance version of the XF2R-1 Dark Shark Fireball—Ryan was the first American manufacturer to develop an afterburner, conducting his work under Navy Bureau of Aeronautics contract.

The XF2R-2 was designed around the Fireball jet-plus-propeller principle. In

(Continued on page 19)



First commercial manufacturer to develop an afterburner, Ryan worked on project for Navy. This is early design shown in the Ryan jet test cell.

Ryan supervisors Robert Chase and James Ring (l. to r.) consult with G-E inspector Jim Donovan on afterburner fuel-injecting cone.

CONNECTING LINK

From KC-97 pod to B-47 tanks, Ryan products bracket this flying pipeline between two great Boeing planes.

Two heads are better than one -- if they get together

Boeing inspector Henry Courtney (left) and Ryan production executive Henry Berlinghof "talk tanks" under the swept wing of the speedy B-47 with its mammoth Ryan fuel cell.

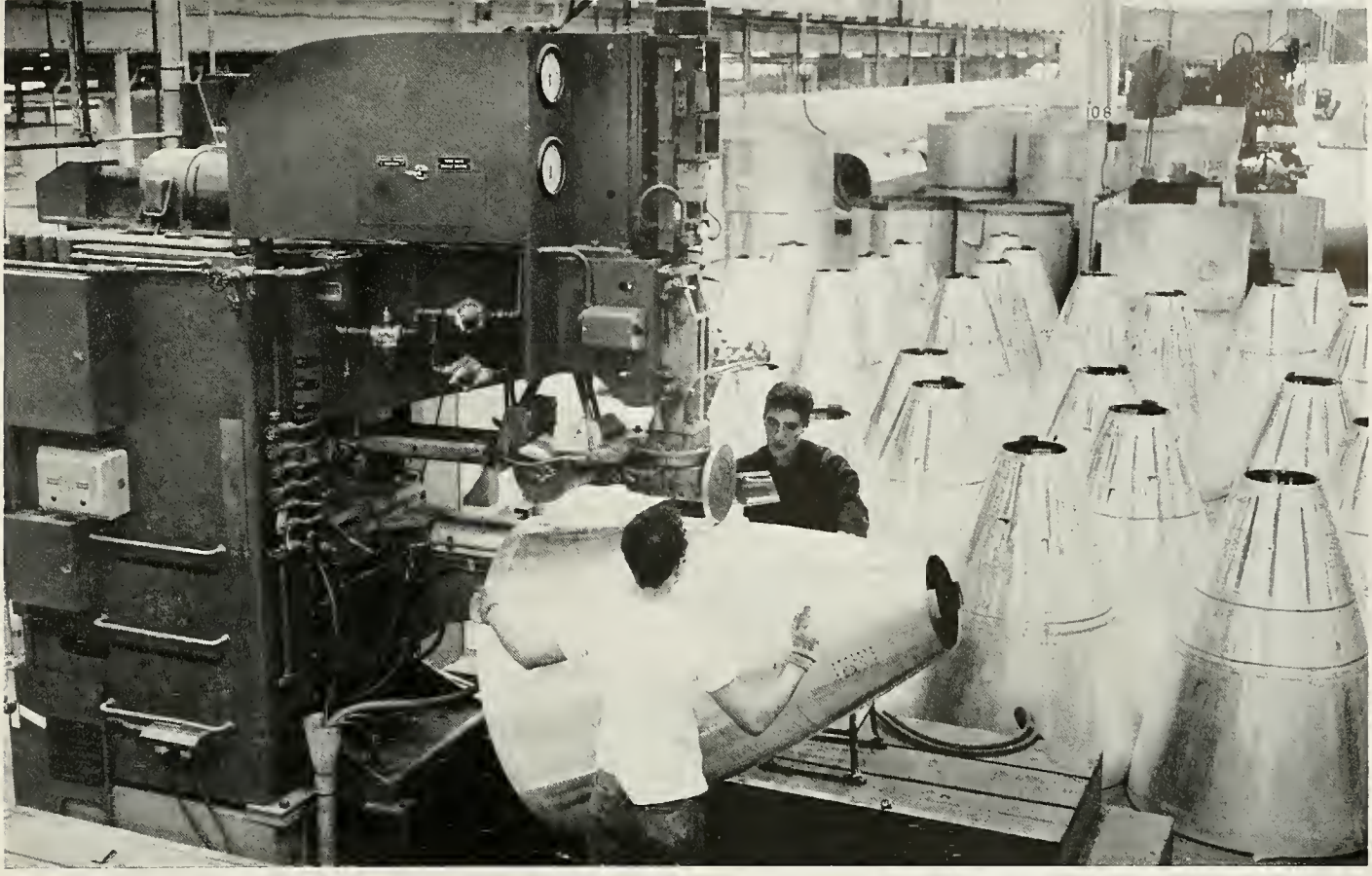
AS close as the connecting link between flying tanker and bomber in the mid-air refueling of a Boeing B-47 is the liaison between Ryan Aeronautical Company and Boeing Airplane Company, Wichita, Kansas on the fabulous external fuel tank project.

These tanks, largest of their kind in the world, were designed some three years ago, when Ryan was awarded the contract to build great quantities of these fuel containers to extend the range of the speedy B-47.

Since then, key production, engineering, inspection and tooling officials of Ryan have virtually shuttled between San Diego and Wichita to keep production rolling smoothly, and Boeing personnel have occasionally come to the Ryan plant as inevitable problems arose.

Much of the liaison on the fuel tanks has been performed by communications across the desk of Joe Richert, the Ryan customer coordinator on the project, and by personal visits of James Stalnaker, Ryan field service representative assigned to Boeing, who divides his time between the Seattle and Wichita plants.

But often it has been imperative for factory personnel to be on the scene at Wichita at crucial periods. Thus, when the tanks were first tested in



Torpedo-like tail sections of Ryan tanks are welded on king-size machines of special design. 30,000 spotwelds close tank seams.

flight, Henry Berlinghof, Jr., executive assistant to the production manager, went to Wichita and stayed for some time, observing the results and ascertaining that the performance was as anticipated.

When it was deemed advisable to change the fairing on the tanks, Berlinghof again traveled to Wichita to present the engineering proposal, to get Boeing's ideas, and obtain full approval for the modification.

"Personal contact accomplishes in a day or two what might require months of tedious exchange of reports," explains Berlinghof, who has been Ryan's principal "connecting link" with Boeing.

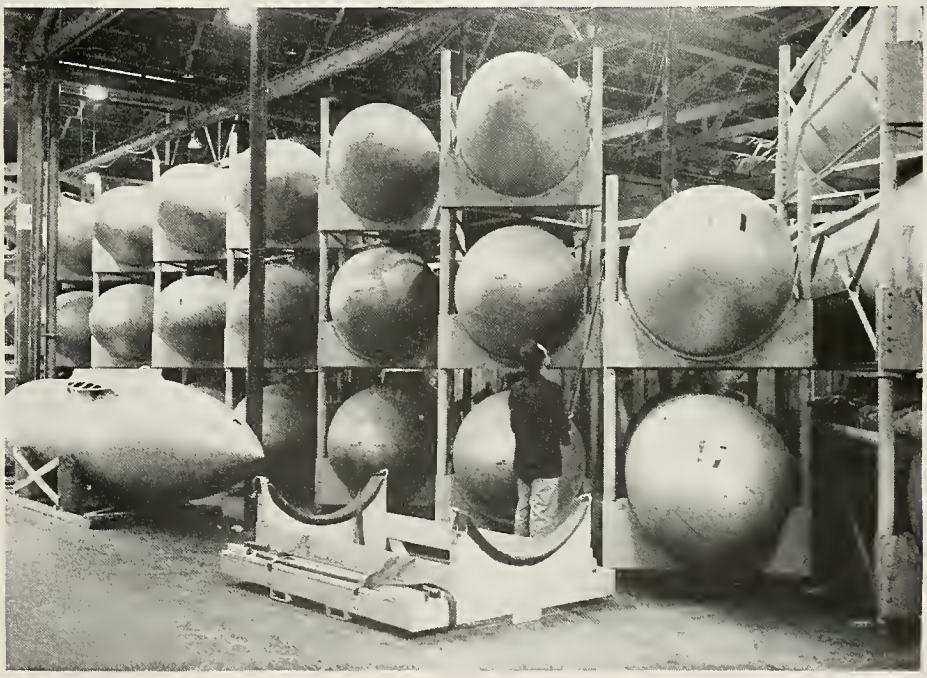
"Decisions can be made and coordinated on the spot. Time and money are saved, and the job is finished sooner."

Boeing often has suggested design changes in visits of its representatives to Ryan, and the result has been sharp reductions of manhours per tank. Many problems arise that can be appreciated only by an inspection in the factory. Boeing has sent officials to San Diego to learn for itself the engineering, scheduling and storage problems on the huge tanks. At one time, inavailability of fuel pumps caused a delay in shipping of the tanks completed by Ryan, leading to a serious storage situation in a plant jampacked with production work. When Boeing representatives made a personal survey, they agreed to permit Ryan to ship the tanks to Wichita without the fuel pumps, which were later installed at Boeing, instead of at Ryan as was customary.

This sort of give-and-take is possible only through close liaison and face-to-face meetings, Berlinghof points out.

(Continued on page 18)

Looking like crated eggs, a goodly supply of big Ryan fuel tanks are stored at the Boeing-Wichita plant awaiting installation in Stratojets flowing from production lines.



FUEL TANK PURGING REVEALED

THE ever-present hazard of fires aboard combat and transport aircraft has been attacked on new fronts as the result of research Ryan Aeronautical Company has recently completed under U. S. Air Force contracts. The studies Ryan conducted were designed to minimize the in-flight danger of explosions due to combustible mixtures of fuel-air vapors in fuel tanks; in the surrounding areas, and in engine nacelles.

If the goal of aircraft "purging" systems under study is achieved, the efficiency and safety of flight operations will be vastly increased.

The high aircraft mortality rate resulting from fuel tank fires and explosions during World War II prompted extensive studies of possible systems for protection both by the U. S. Air Forces and by the British. In this country, considerable research was done at Cornell Aeronautical Laboratory and has since been further advanced by Ryan and other industrial firms.

When fuel tanks are full, the danger of explosion or fire is relatively slight but as the fuel is used, it is replaced by air which absorbs gasoline vapors and forms a combustible air-fuel mixture.

Obviously, if an enert gas containing little or no oxygen could be introduced in the fuel tank areas at the same rate as the fuel is withdrawn, the oxygen content of the air would be maintained well below the combustible point.

A number of different plans have been proposed and are now being developed to reduce the oxygen content of the space above the fuel below that sufficient to sustain combustion. Bullets and shells from enemy aircraft, static electricity, or spontaneous combustion can lead to disastrous fires which may occur within the fuel tank or in the areas inside the wing adjacent to the tanks. Perhaps an even more critical area is that within the engine nacelles, for it is here the greater incidence of fire in flight has been recorded.

Three basic sources of inert gas have been proposed and extensively studied. One system involves carrying noncombustible carbon dioxide or nitrogen under pressure in metal cylinders. Another suggests the use of exhaust gases from the aircraft's engine. A third pro-

Fire control for a B-36, Ryan's previously unrevealed gas purging system has been tested in the huge intercontinental bomber.

poses a small independent engine solely for the purpose of generating inert gas or use of exhaust gas generated by auxiliary power plants. All these systems present complex design problems for the engineer.

Comparing the two gases suggested for the bottled gas system, CO^2 requires a considerably smaller container because it can be compressed to approximately one-fifth of 1 percent of this original volume. However, because of the pressure under which it is carried, it requires a thick-walled cylinder and creates the possibility of explosion should the container be hit by enemy fire.

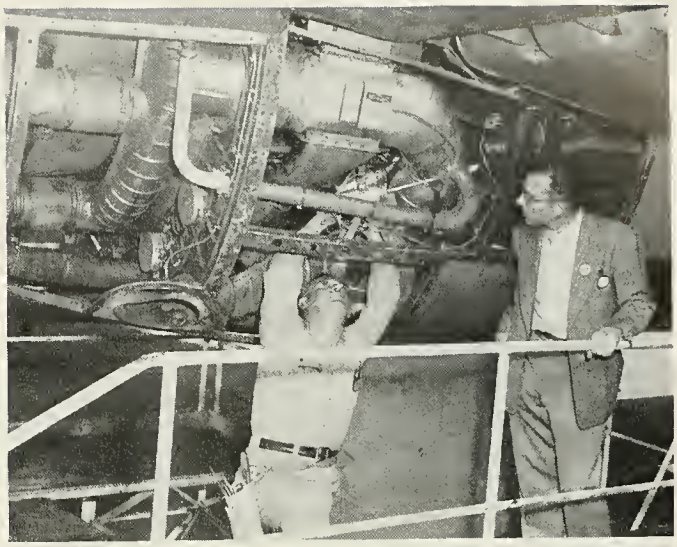
Nitrogen, on the other hand, is only one-third as heavy as carbon dioxide, but not nearly as compressible and therefore requires a larger bottle. Analyzing one against the other, studies have indicated that the weight requirements are approximately the same for carbon dioxide as for the nitrogen system. For a four-engine long-range aircraft, the bottle gas system might weigh as much as 800 pounds, creating a serious weight problem. But even more serious is the necessity of having some source of supply at operating bases. This would create a rather difficult logistics problem, especially during combat in wartime.

Likewise, a system which would use exhaust gases presents a problem not only of technical perfection but of weight. This inerting system involves accepting gas at the engine exhaust collector, conducting it through a heat exchanger where it is cooled, and where moisture and corrosive substances are removed as a condensate. The gas is then further cleaned and distributed at the desired operating pressures through the area to be purged. This displacement of air by inert gas provides an atmosphere which will not sustain combustion.

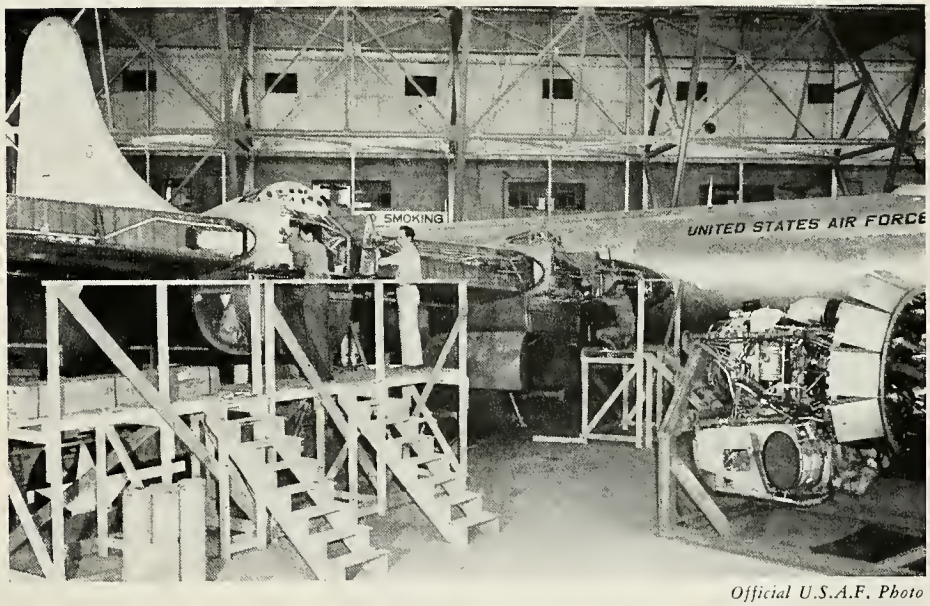
The exhaust gas system has definite advantages over the bottled gas method at least insofar as logistical simplicity is concerned for it automatically provides a continuous source of inert gas. Many difficult technical problems, however, indicate the final decision between the bottled, exhaust gas and inert gas generator systems, or others being studied, is still in the future.

The Ryan purging project is directed by W. W. Vyvyan as project engineer. Other Ryan staff engineers on the purging project are H. K. Peck, design group eningeer and J. R. Hanson, flight engi-

(Continued on page 23)

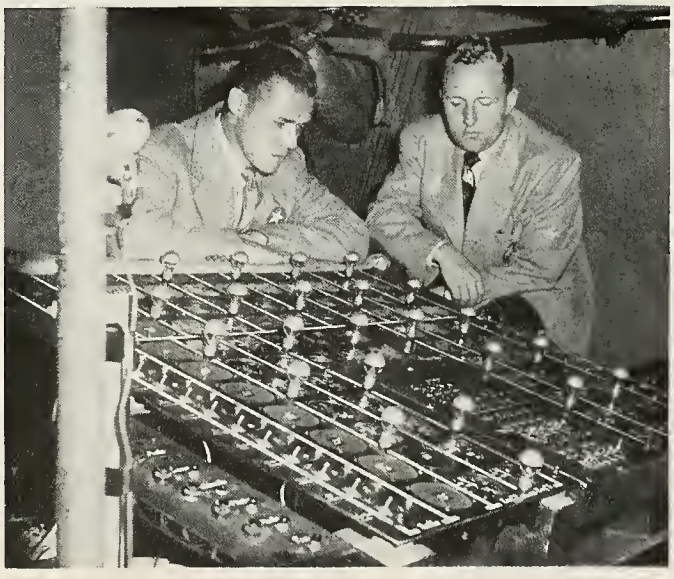


Ryan mechanic places purging gear in B-36 nacelle at direction of Dick Preece (right) Ryan engineer. Tight liaison between mechs and engineers is a necessity because of the new field of exploration covered.



Official U.S.A.F. Photo

Installation of Ryan purging system is accomplished in Boeing B-50 Superfortress by foreman James Key (left) and test mechanic Murray Wick prior to extensive flight test.



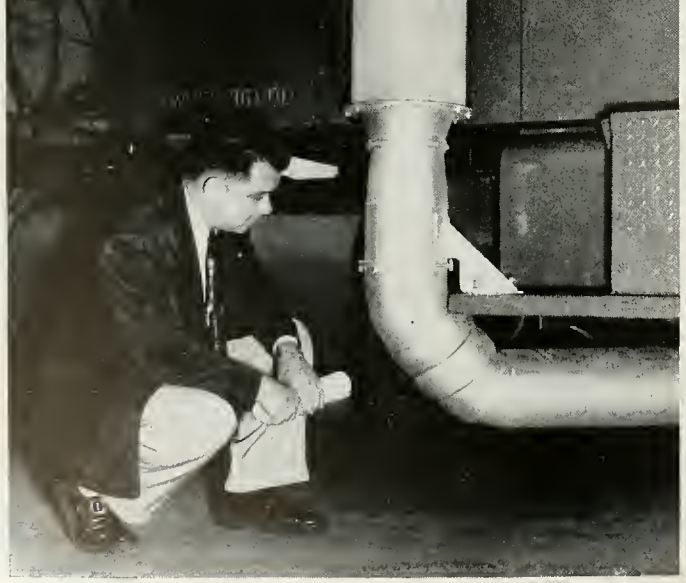
Instrumentation panel for B-36 purging tests is checked by engineers John Fisher (left) and James Hanson. In panel, recording instruments are viewed by cameras to obtain a running record of data.

Framed in the apparently engine-less hood of the Kenworth truck at Ryan is top spectator: President T. Claude Ryan.

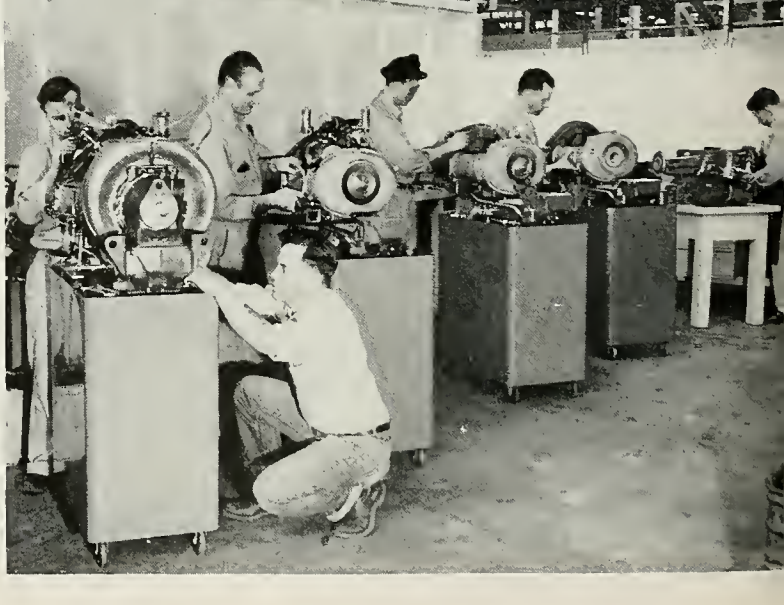
Interesting application for the new Boeing gas turbine power plant i this 24-foot Navy personnel boat shown in test run on Lake Washingtor

On land . . . . On sea . . . .

Exclusive Ryan ball-and-socket joints, in truck's exhaust system, are examined by C. L. Faushee, Ryan Service Manager.



Earmarked for Navy minesweepers, Boeing's compact, new prime move is being produced for Bureau of Ships. Many other uses appear feasibl

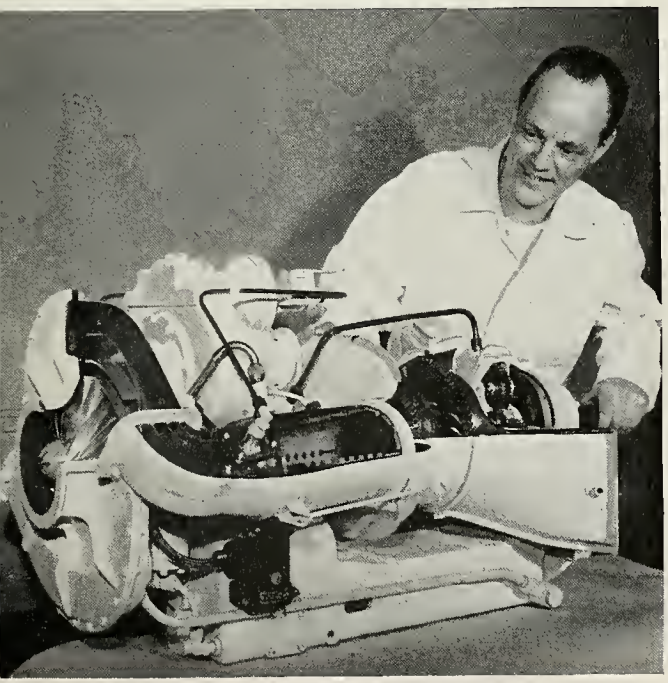


First helicopter to be powered by gas turbine, the Kaman K-225 uses the Boeing engine in unique turbo-rotor hook-up.

BOEING'S JET TURBINE

...and in the air

Cutaway model reveals elements of the 200-pound gas turbin which give it the power of Diesels fifteen times heavier.



IN a sizzling highway dash, linking three countries, Boeing Airplane Company has launched the world's first gas turbine-driven truck. Streaking from the Canadian to the Mexican Border in less than 60 hours, this 55,000 pound Kenworth truck and trailer is powered by a tiny Boeing gas turbine weighing only 200 pounds.

Designated Model 502, the revolutionary new engine has no radiator or cooling system and only one-tenth as many parts as a comparable diesel or gasoline power plant. It develops 175 horsepower in a package which is 3000 pounds lighter in weight than the diesel engine which it replaced. Without reciprocating parts, it promises a new era in motor transportation in which piston and connecting rod throb, staccato exhaust blast and combustion knock will be unknown.

Similar in basic design to jet airplane engines, the Boeing gas turbine has one important difference: the hot gases generated are used to spin a geared turbine rather than produce a jet stream. Its design embodies two distinct and separate units: a power section and a drive section.

The power section consists of a centrifugal-type compressor which sucks in large volumes of air and packs it into two stainless steel combustion chambers. Fuel burned in these chambers expands the air tremendously. The seething exhaust gases rush through a turbine wheel which spins at 36,000 rpm to power the compressor.

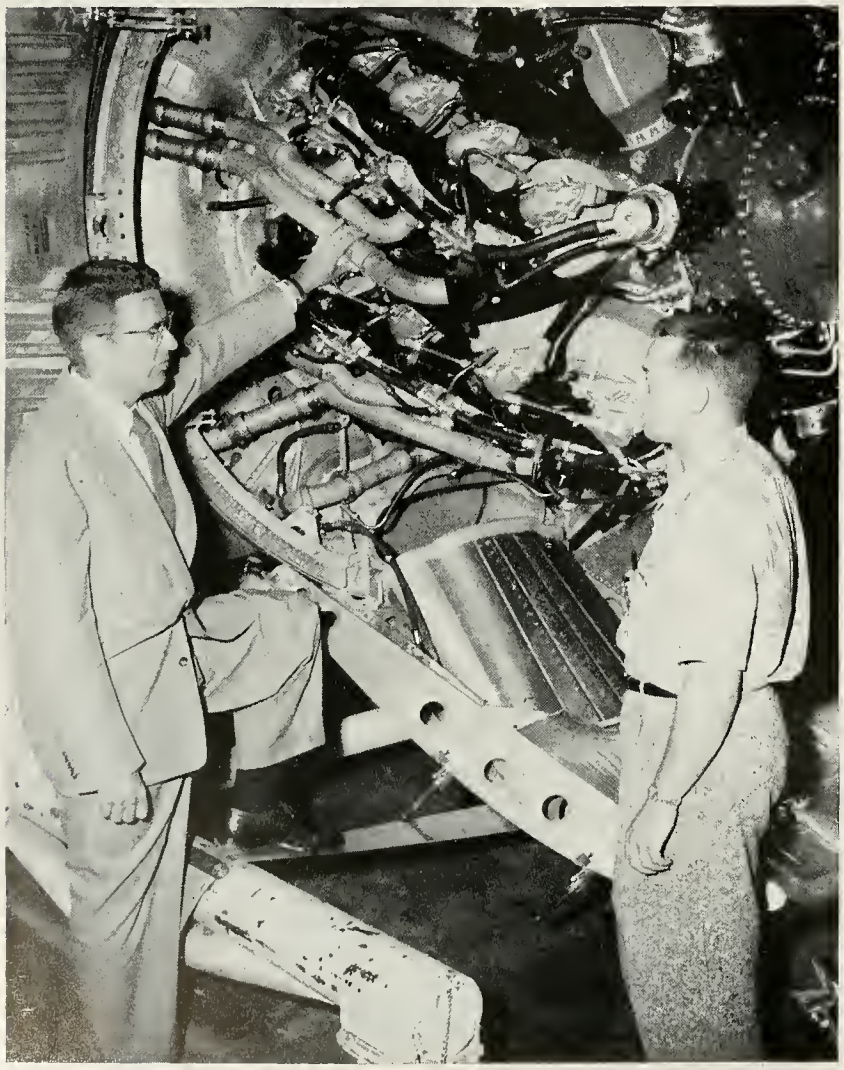
From this turbine, the accelerated exhaust blast is projected to another turbine which is geared to the truck's drive shaft. Whirling at 22,650 rpm, this turbine actuates a train of 8.62 to 1 reduction gears which give the drive shaft a rotational speed of 2500 rpm.

There is no mechanical connection between the two turbines. One actuates the other much like a fluid drive mechanism in an automobile. This advantage provides an infinitely variable transmission which precludes stalling of the gas turbine under any load conditions.

At the conclusion of its 1445-mile run down the Pacific Coast, the big Kenworth truck was brought to the Ryan plant where engineers and production experts studied the small but

(Continued on page 20)

200 troops emerge fresh and fully equipped from the clam-shell maw of a huge Douglas C-124 Globemaster II after a 1000 mile filght.



Weighing in at 175,000 pounds, the Globemaster is new heavy weight champion

Jack Lucast (l.) Ryan service representative, and T. F. Wall, Douglas engineer, discuss the Ryan-built exhausts which serve Globemaster engines. Ejector design uses thrust reaction to attain increased speeds.

50 tons of combat cargo hit Korea as another big Globemaster arrives and is readied for unloading. The mammoth transport can carry 94 percent of all military vehicles fully assembled ready for the field.

FLYING WAREHOUSE

A 'broad-muscled giant."
An "ugly duckling."
A "flying warehouse."
A "two-story flying barracks."

Inspiration for these descriptive phrases is the new colossus of long-range strategic airlift, the Douglas C-124 Globemaster II, which lays no claim to beauty but rightly boasts that it can carry more stuff farther than any other U. S. transport.

You start groping for comparisons the instant you see this ungainly double-deck leviathan. One witness observed, after watching a C-124 take off:

"There is a touch of the ludicrous about the trip down the runway, for the C-124 looks like nothing more than the hefty Katrinka of the comic strips on the dead run, her skirts held high off the ground."

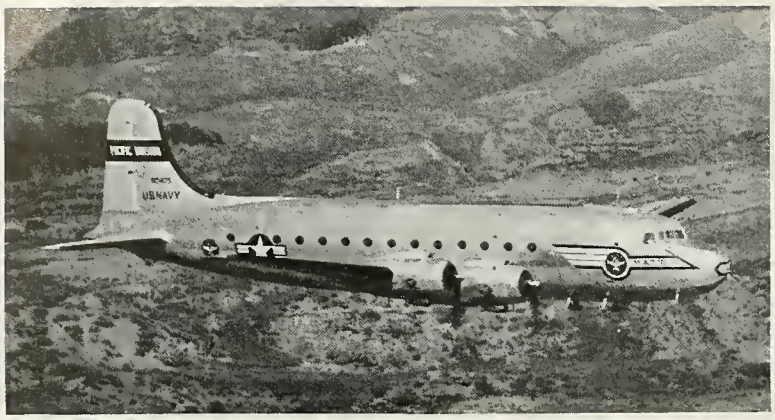
You wonder whether the ugly duckling will even be able to become airborne. The Globemaster, however, acts with calm confidence. Her high-lift wing easily helps her off from any standard civilian airport, and only a portion of the long Air Force runways is needed by the surging power provided by four 3500 h. p. Pratt & Whitney Wasp Majors, equipped with Ryan exhaust systems.

Developed jointly by Douglas and Ryan engineers, these exhaust systems are unusual in configuration. A Ryan "Siamese stack" design is employed in which fourteen individual header sections scavenge the hot exhaust gases from each pair of the Wasp Major's 28 searing cylinders. All header sections are brought to the upper part of the engine nacelles to eject the gases to the atmosphere above the leading edge of the wings.

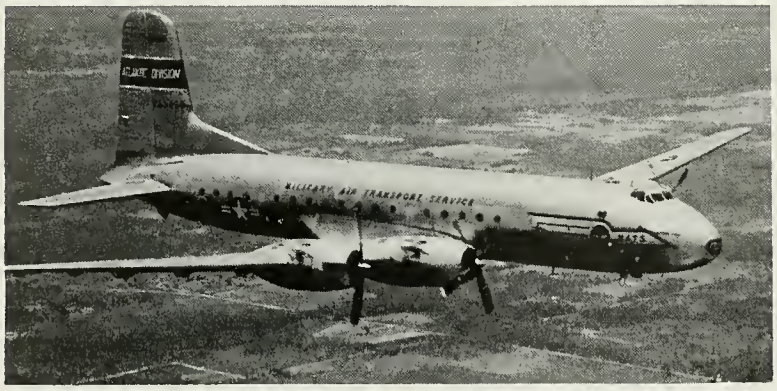
In each engine installation, the eight upper header sections are relatively straight stacks. Added thrust is imparted to the C-124 by the jet reaction of the escaping gases. The exhaust tapped in the lower circumference of the engines is channeled through semi-collector tubes which direct it upward to the exit troughs.

Although the outlets of all headers are rigidly attached to the nacelles, the engines are free to move with temperature changes, torsional rotation and

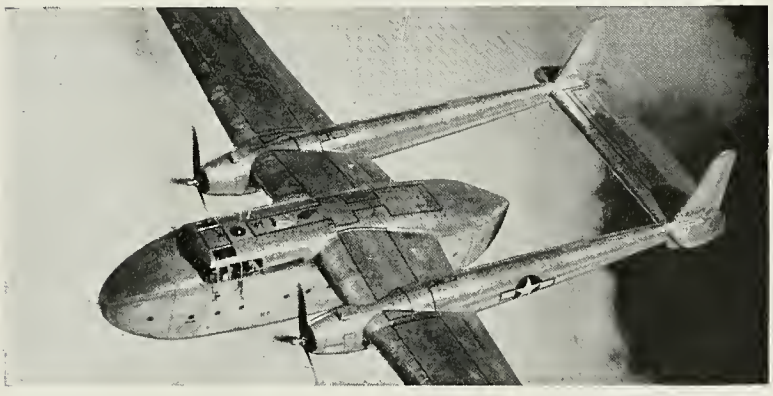
(Continued on page 21)



DOUGLAS C-54



DOUGLAS C-74



FAIRCHILD C-82

BOEING C-97

**Colonel Raymond Curtice, 1500th Air Transport Gr
Dorothy Menge and Ensign Joan Cordone, just ar**

GLOBA
TRAN

DATE: June 25, 1950.

TIME: Early morning.

WEATHER: Clear and crisp.

PLACE: Kimpo Airfield, Korea.

Out of sight, below a slight ridge, stretches the crisscross runways of the airfield. Beyond them, the muddy orange-yellow waters of the Han River lap lazily at the sandy shore.

A single plane squats on the terminal ramp facing the runways. She is a Military Air Transport Service Douglas C-54.

Outside, her crew moves beside her, check-

MATS PRIMARY

Seven of the eight multi-engine tran considered by the Military Air Transport equipped with Ryan exhaust systems.

Fathered by the Army's and Navy' Command and Navy Air Transport Servi manent, integrated military air transport

Its great contributions have been was formed, and the present Pacific Airl

mmander, greets nurses Captain Alta Clark, Captain
t Hickam Field from Japan to discuss Pacific airlift.

L AIR PORT

ing over the plane for the flight back to Japan.

Bleak mountains surround the field on three sides. They give a hint of peace and quiet and majesty to early morning. The air is clear, cold and crisp.

Such was the setting.

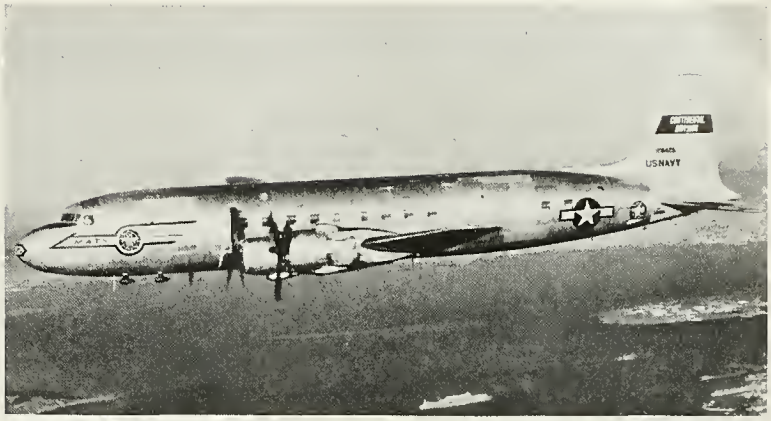
Suddenly, without warning, a Russian-type Yak streaked in over the mountains from the North, veered toward the parked aircraft and slammed 20 mm explosive shells into its fuselage. Before the Yak had passed over the C-54,

(Continued on page 14)

ANSPORT TYPES

lanes pictured on these pages—which are
ce as their primary transport types—are

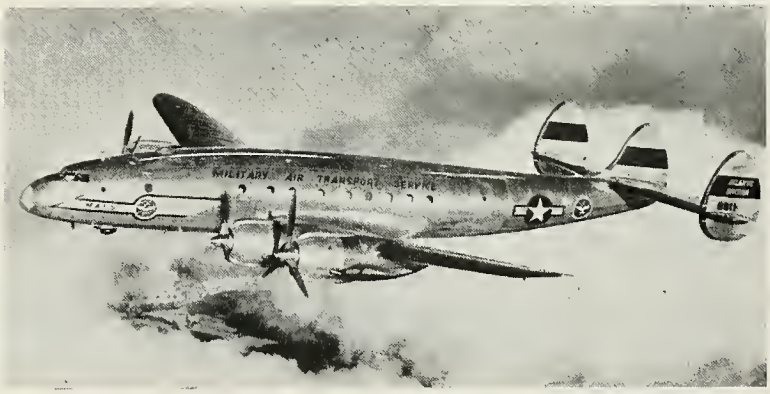
d War II transport services—Air Transport
TS was set up four years ago as the per-
ion of the Department of Defense.
lin Airlift, started three weeks after MATS
upport of the Korean war.



Department of Defense Photo

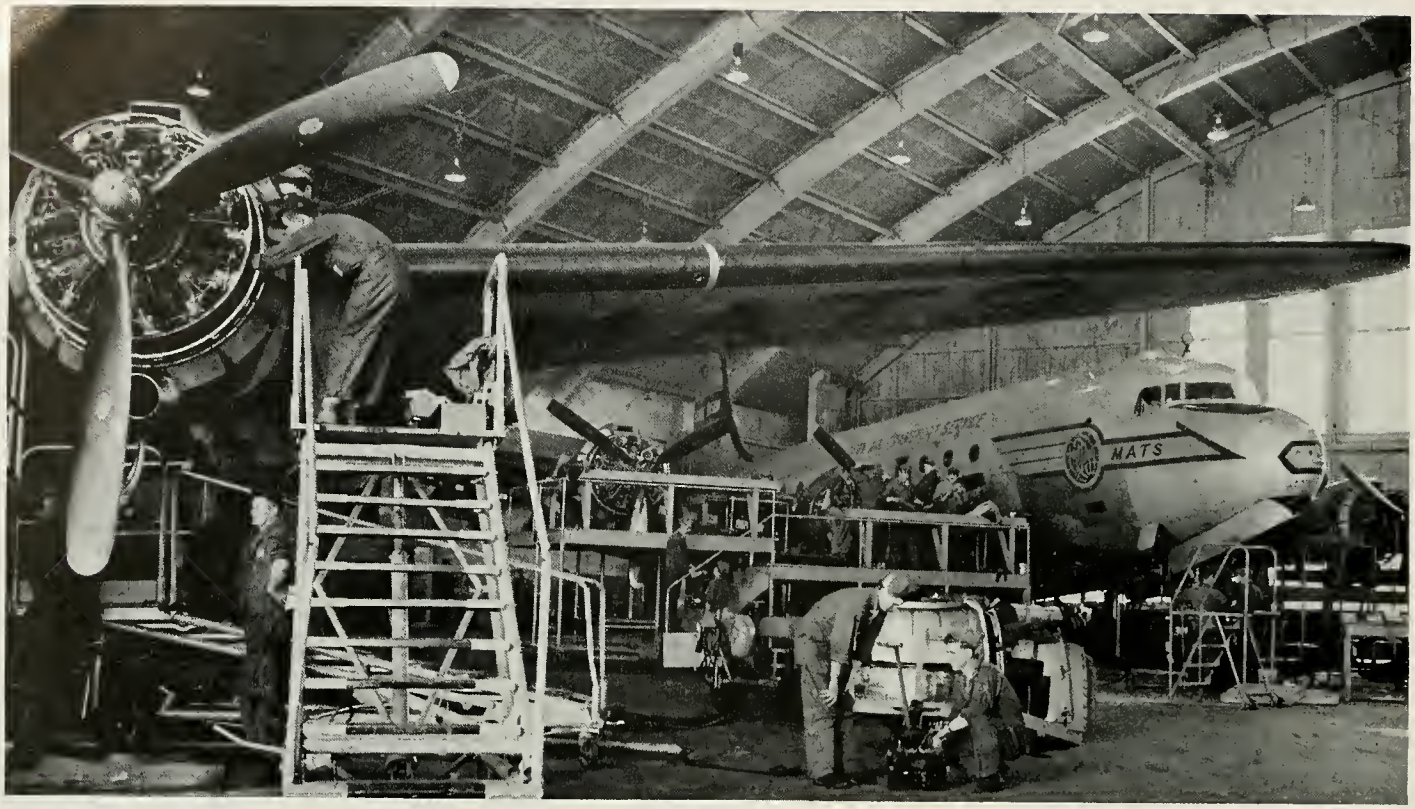
DOUGLAS C-118

FAIRCHILD C-119



LOCKHEED C-121

DOUGLAS C-124



Although widely used throughout MATS armada of transport planes, Ryan exhaust systems cause power plant personnel little concern.

great gaping holes opened in its side as if by magic.

Thus, in a symphony of shells, began for MATS another phase of its spectacular four-year record in airlifting high-priority passengers and cargoes for all of the Armed Forces in overseas areas.

When the North Koreans crossed the 38th Parallel, the Military Air Transport Service was two years old, and already had one remarkable peacetime achievement—the Berlin Airlift—tucked under its belt. On June 25, 1950, exactly two years after the Russians rang down the iron curtain around Berlin, the vast fleet of MATS aircraft and resources again was called upon to support United Nations forces.

Critical medical supplies, specialized ammunition, ordnance equipment, radio, radar, electronics equipment and aircraft spare parts were weeks away by sea lanes.

A formula was needed to solve the TIME vs. DISTANCE supply problem for certain critically needed men and material.

Only one answer spelled out the solution to this problem: 24-hour-a-day, 7-days-a-week strategic airlift.

Before Korea, fewer than 60 MATS aircraft were carrying about 70 tons a month to Japan. By September 1, 1950, a maximum of 250 military, commercial and United Nations aircraft were airlifting a daily average of 106 tons of critical cargoes to the entire Pacific area.

The Pacific Airlift, the longest aerial supply line in history, has now recorded more than 150 million plane miles—

(Continued on page 22)

Giant Douglas C-74 Globemaster disgorges 25 tons of flour in Berlin in typical operating during blockade in which MATS airlifted 2¼ million tons to the city.

Military leaders and top scientists of the nation, members of the Research and Development Board, which coordinates all military experimental work, recently visited restricted areas of Ryan plant to peer into the future by viewing advanced secret projects.

PEERING INTO THE FUTURE

DISTINGUISHED visitors to the Ryan plant in recent weeks peered far into the future as they inspected secret advanced projects based on daring new concepts of aeronautical design.

John Floberg, youthful Assistant Secretary of the Navy for Air, flew into Lindbergh Field, and conferred with Ryan engineering and executive personnel, besides viewing a revolutionary type of experimental work being performed for the Navy.

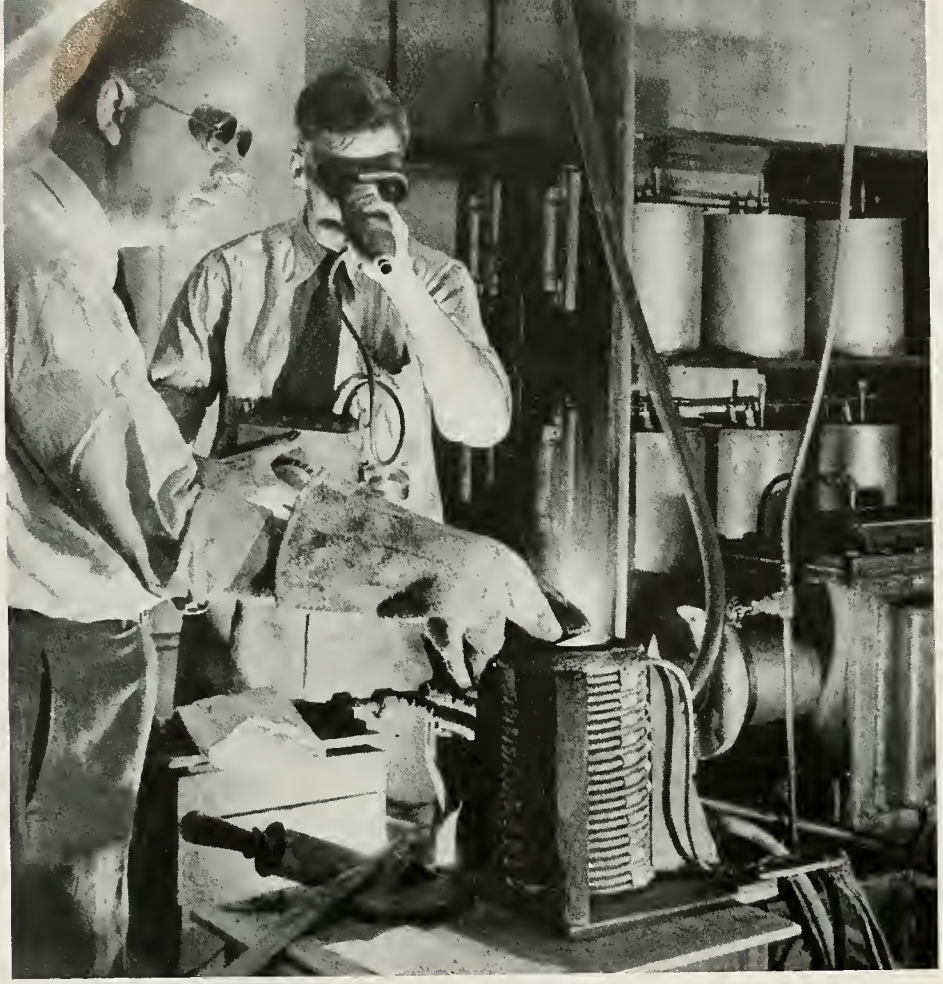
John Floberg, Assistant Navy Secretary for Air, confers with T. Claude Ryan during recent visit.

Two days after Floberg's visit, Ryan played host to the Research and Development Board, which coordinates all military experimental work. The group, headed by Walter G. Whitman, included six generals, an admiral and such famous scientists as Dr. Hugh L. Dryden and Dr. C. C. Furnas.

Only 36 years old, Floberg recently qualified as a carrier pilot after three successful solo landings aboard the U.S.S. Cabot. He recently also made a parachute jump with a Navy crew over the test base at El Centro, Cal. At Ryan, he was accompanied by Capt. James Thach, famed Navy aviator who developed the "Thach weave" combat maneuver in World War II, and Comdr. Cedric Stirling, Navy Bureau of Aeronautics representative in San Diego. *(Continued on page 18)*

Close-up look at a confidential project is provided members of Research and Development Board by Ryan engineering department officials. The group was headed by Walter G. Whitman, and included generals, admirals and many distinguished scientists.

Assistant Navy Secretary John Floberg examines Ryan development. Left to right, William Immenschuh, executive engineer of Ryan; Comdr. Cedric Stirling, Capt. James Thach, Bruce Smith, engineering director; Floberg, and T. Claude Ryan, president.



Metal melts instantly in this ceramic furnace but it cannot even warm a man's hand. Built by International Nickel, it is heated by water-cooled, electric induction coils.

High Temperature Metallurgy

Written especially for
Ryan Reporter
by
DR. BERNARD P. PLANNER
Metallurgist and Staff Consultant
James H. Knapp Company

WE are living in a "high-temperature age" which is placing increased responsibilities upon the metallurgist to create superior heat-resistant materials for converting thermal energy into ordered kinetic energy. Especially is this true in the fields of jet engines, rockets and gas turbines which are of special interest to the aircraft industry.

There has been a steady temperature increase from the 800° F. to 1200° F. range, which was satisfactory for highly stressed parts in 1930, to the jet engine and rocket requirements of today's high temperature "super-alloys" with a range of from 1200° F. to 2000° F.

Two outstanding examples of successful high-temperature applications might be mentioned. One is the afterburner, similar to those the Ryan Aeronautical Company is building, which is an extra combustion unit located in the tailpipe behind a turbojet engine. Utilizing the unburned oxygen in the turbojet exhaust, this device gives the jet plane needed short bursts of increased speed and climb for take-off and combat maneuvers.

Temperatures run to 2000°F. in huge Knapp furnaces such as this new addition to the Ryan plant. Maurice Musgrave checks the operation of furnace and Ryan loading racks.

Alloys such as Haynes Multimet and Haynes No. 25 are used for the hottest parts of the afterburner, where jet gases approach 3000° F. in temperature and are accelerated from 300 to 1800 miles-per-hour—putting the materials used to a grueling test.

Another example is Ryan exhaust systems which are fitted to Pratt and Whitney 3500 h.p. radial aircraft engines. These structures must withstand withering vibration and temperatures running to 1800° F. for continuous operation over extended periods. Ryan has successfully coated these components with thin ceramic coatings which substantially

DR. PLANNER

Few metallurgists have enjoyed the international experiences which Dr. Planner has received. The son of an Austrian steel mill manager, he studied metallurgical engineering at German and Swiss universities. He taught at the State University of Engineering in Berlin before entering into the industrial field. His affiliations in industry include various German manufacturing plants as well as eight years of service with an outstanding firm of technical consultants. In this work he was a consultant to plants in Germany, France, Switzerland, Poland, England and Czechoslovakia. Dr. Planner came to this country in 1941 as metallurgical consultant for the Board of Economic Warfare. Later, he worked with U.S. Steel, Sperry Gyroscope, Douglas Aircraft and other companies before affiliating with Knapp industrial furnace company of Los Angeles as staff consultant.

extend their useful life by protecting their surfaces against oxidation and corrosive attack.

In discussing super alloys, or materials for ultra-high temperatures, it is important to distinguish between four different groups of materials: (1) metals and their alloys; (2) ceramic coated metals; (3) ceramic bodies; and (4) combinations of metals and ceramics, or cermets.

The evaluation of properties which super alloys should have for high-temperature applications merits consideration. They must have load-carrying ability at high temperatures, certain ductility and resistance to; oxidation, corrosion by humidity, combustion gases, propellants such as sodium peroxide in rockets and guided missiles, erosion and thermal shock. No one material will meet all of these requirements and a reasonable compromise will be necessary.

A conception of the specialized functions of high-temperature metals can be obtained when it is realized that a structural carbon steel, with a room temperature ultimate tensile strength of 140,000 psi, would have a UTS of only 1000 psi after exposure to 1400° F. for 1000 hours.

Analyzing the different types of materials we find that metals are, generally speaking, ductile and, therefore, to a certain degree resistant to thermal shock. They have good thermal conductivity and are reasonably resistant to mechanical shock. Unfortunately, the metals with the highest melting points are not at all resistant to oxidation. Heated in air, they oxidize, decompose rapidly and burn within a very short time.

An example of this phenomenon is tungsten, the strongest of known pure metals, which has the highest melting point of any metal—6200° F. At room temperature, its strength for a 1-mm wire is 200,000 psi; for a .10 mm wire, 426,000 psi; and for a .015 mm wire, 670,000 psi—highest physical strength of

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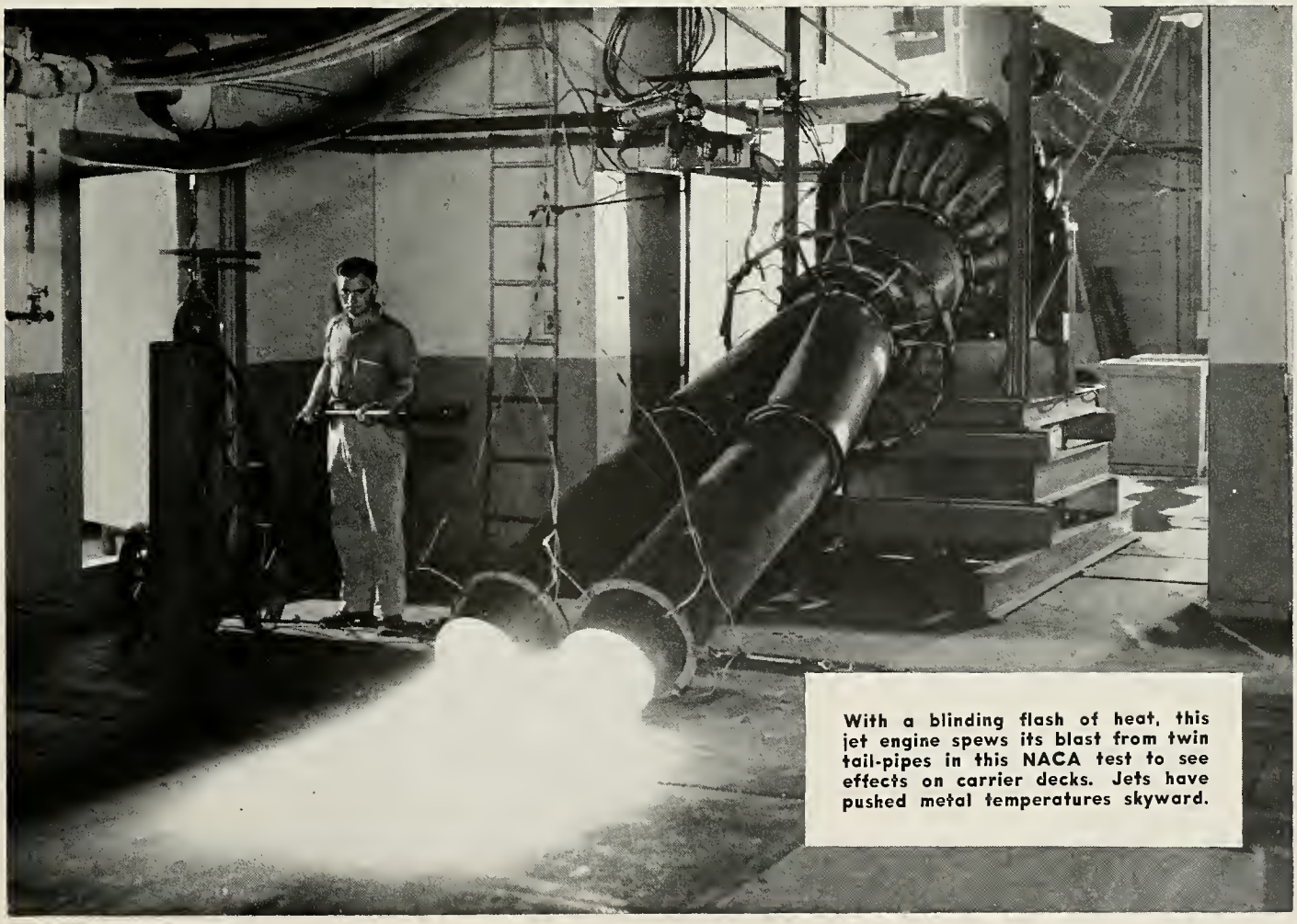

With a blinding flash of heat, this jet engine spews its blast from twin tail-pipes in this NACA test to see effects on carrier decks. Jets have pushed metal temperatures skyward.

CONNECTING LINK

(Continued from page 5)

When it became necessary some time ago to rework a certain feature of the tank resulting from an engineering change, it was mutually decided that it would be cheaper to do this in the Wichita plant than to ship the tanks back to San Diego. Berlinghof led a team of five specialists, including production and inspection personnel, who remained in Wichita for ten days while instructing Boeing personnel on techniques necessary to perform the rework. The result: thousands of dollars of shipping expenses and production manhours saved.

"When we go to Wichita or Boeing people come to San Diego, it's usually to solve a specific problem," Berlinghof explains. "But we stay to iron out a dozen other details that need attention."

Besides Berlinghof, frequent "commuters' to Wichita have been Paul Matherly, of Ryan engineering; and A. S. "Bill" Billings, chief inspector.

One of the most important objectives of the close Ryan-Boeing liaison is the constant search for improved metals and better methods. No job is frozen in its materials or techniques. Research developments may lead to changes in specification requirements, accomplished at conferences which have usually been conducted in Wichita.

Tooling coordination is another major essential. Ryan's master gauges must be checked occasionally against the control gauges at Boeing. The control gauges check the master gauges, which check production tooling in the Ryan plant to insure accuracy.

In the American system of wide distribution of work on any one plane, with parts flowing in to an airframe factory from hundreds of subcontractors throughout the country, liaison such as exemplified by the Ryan-Boeing relationship, is essential for uninterrupted output.

PEERING into the FUTURE

(Continued from page 15)

During the same week, high-level conferences were held at Ryan with officials of the General Electric Lockland, O., gas turbine division, for which Ryan produces numerous component parts. The visitors included C. W. LaPierre, general manager; F. Estes, purchasing agent for the Lockland plant; Col. D. Strickland, in charge of the Cincinnati region for the Air Force; and Maj. Richard Iverson, resident Air Force representative at Lockland.

Second Lieut. David Ryan

History Repeats Itself!

History is repeating itself in the Ryan family.

At about the same age T. Claude Ryan was when he received his Army Air Corps pursuit pilot's rating, back in 1921, his son, David, now 22 years old, has won his Air Force commission as a jet fighter pilot. His wings were pinned on by his father at recent ceremonies at Williams Air Force Base, Arizona.

Second Lieut. David Ryan thus bridged the gap of three decades between the Liberty-powered De Havillands his dad used on peacetime missions of forest fire patrol, to the F-86 Sabrejets he will soon fly in combat in Korea.

The youth, who made many friends among Ryan employees during periods he worked in the plant, trained for the last six months in T-33s (two-place jet trainers) and F-80 Shooting Stars.

Dave began his military career when he volunteered as an Air Force private and went through basic training at Lackland Air Force Base, Texas. Later he was accepted for aviation cadet training and received pilot instruction at Bartow, Florida for more than half a year.

With 200 hours of flight training behind him, 2nd Lieut. Ryan has reported to Nellis Air Force Base, Las Vegas for ten weeks' gunnery training in F-80s and F-86s. This will be followed by brief processing at Camp Stoneman, California, en route to Korea.

On hand to see Dave's father pin on his wings was the newly commissioned officer's mother and two brothers, Jerry, 20, and Steve, 13. Jerry has worked summers in the experimental department and has been in the Air Force R.O.T.C. at Stanford University.

FUEL ON THE WING

(Continued from page 1)

abling elimination of internal wing tanks.

Why external fuel tanks? Despite their teardrop configuration and aerodynamic "smoothness," don't they increase drag and slow down the plane? Obviously they do, to some extent, but the C-119H was deliberately designed for increased safety and lesser speed in order to gain numerous advantages for the missions assigned it.

In an era when premium is placed on speed, the C-119H is unique as probably the first military aircraft considered successful because it is slower than its predecessors, the C-119C. Engineers were instructed to reduce the cruising speed because the C-119H is destined for use primarily in paratroop operations, and a low drop speed is more essential than a high cruising speed.

The most obvious change in the C-119H is in the fuel system. Safety engineers rhapsodize over the use of external tanks. They say that the exposed "inflammable" area—virtually the entire wing in an internal fuel system—is reduced by 50 per cent, minimizing gunfire hazard. Leakage will not affect the structure, the engines or the ignition system. In event of a crash, the tanks will rip off and again cut fire hazard. Seriousness of a fire while in flight will be lessened because of the tanks' isolation, and the slipstream which would tend to snuff out the flames. Gasoline fires might well be confined to the tanks with minimum damage to the airframe.

Considerable weight—as much as 800 pounds—is saved by eliminating the fittings, connections, access doors, etc. of the 22 internal wing fuel cells. Maintenance and servicing are simplified, and stockpiling of replacement parts is sharply reduced.

For instance, there are 312 "V" boards in the fuel system of the C-119C, none in the "big wing" model; 7 valves in the "C," compared with 3 in the "H;" 4 pumps against 2; 6 gauges against 4; 5 controls instead of 3; and 90 interconnects to none in the "H."

The fuel system in the "C" weighs 2,442 pounds, while that in the "H" aggregates only 1,607 pounds.

A removable self-sealing blanket can be easily installed on tanks of planes operating in combat to provide added protection. In contrast with the 1600 pounds of weight added to internal

(Continued on next page)

tanks by self-sealing devices, which usually remain on in non-combat zones as well as in combat areas, the removable blankets weigh only 386 pounds.

There are other advantages in the new design. Although on a typical 1800 mile round trip, the C-119H would require 90 minutes longer than the earlier C-119C "Flying Boxcar" and the service ceiling would be reduced from 23,450 to 21,000 feet, the "H" would be able to take off 20,000 pounds heavier than the "C." It would need only 14,600 pounds of fuel, compared with the "C's" 15,700 pounds. Stalling speed is lowered from 103.2 miles per hour to 91.1 miles per hour, and takeoff and landing distances are sharply reduced.

The ability to operate from comparatively short runways is vital, because the military asked for a plane that could move as much as 27,000 pounds of cargo directly into forward staging areas where field facilities might be limited. The C-119H is capable of clearing a 50-foot obstacle after a takeoff run of only 2600 feet, and it lands in less than half that distance. This plane can operate from rough fields that would sorely tax most aircraft of its size and weight. A new rough-field landing gear includes an extra small wheel forward of each of the main wheels.

The big attraction, of course, is payload. A transport's value is based on its capacity to carry cargo long distances economically, and the Fairchild C-119H was designed with an eye to this factor while sacrificing speed. On a mission of 1,000 miles from takeoff to destination, the "H" will carry 22,000 pounds payload, a great performance for a two-engined plane.

This characteristic will be of interest to private operators, and although the "H" at the moment is a military transport, its application to commercial cargo-carrying is a potent possibility. Airlines, scheduled and non-scheduled, have been examining the "H" as a possible replacement for obsolescent equipment.

The lower fuel consumption and greater payload are attributed to a completely redesigned wing from which the 22 fuel cells have been removed. The new wing has 40 per cent more area than on its C-119 predecessors, the span having been increased from 109 feet to 148 feet. Tail area and span also are greater.

WITH the new 3500 h. p. Wright R-3350 Turbo-Compound engines, exhaust gases are directed back to the drive shaft to provide additional power at lesser fuel expenditure.

"The C-119H," says R. A. Henson, Fairchild's chief test pilot, "flies much the same as the 'C' model, but this big-wing version demonstrated much more in-flight stability and control. The 63-knot touchdown speed on landing is amazingly low for this type aircraft."

As a pioneer in the air transport field itself—having created first quantity-production airmail planes in this country (the famed M-1's of the 1920's)—Ryan has a special interest in its contribution to the newest cargo carrier. The external wing tanks of the C-119H may herald a new trend in this field of aviation.

JET HOT ROD

(Continued from page 3)

the nose was a General Electric TG-100 "turbo-prop" engine—a gas turbine turning a propeller. In the aft section of the fuselage was a Westinghouse 24-C jet engine incorporating a Ryan afterburner.

Today, Ryan is building afterburners and afterburner components to augment the thrust of other General Electric and Westinghouse jet engines. Even though these power plants are already more powerful than their piston engine predecessors, additional thrust is needed to zoom interceptors to 40,000 feet and give fighters lightning-like getaway. The afterburner is just the device to provide the kick in the empennage. With the same static thrust as a larger, heavier engine without the re-heat device, an afterburner-equipped plane will have twice the rate of climb, lighter weight and equal, or greater, radius of action.

For taking a wave-off from a carrier, an afterburner may become a pilot's dream. With reduced throttle, a jet engine requires several seconds to develop the increased thrust necessary to accelerate an airplane away from the carrier deck. This delay could put the pilot in the drink. The afterburner can go into action with instantaneous force, taking only a second to boost the plane skyward.

Essentially a ram-jet engine hooked to the tail of a turbojet, an afterburner is a flaming tailpipe which feeds upon the unburned oxygen in the jet stream. In a conventional piston-type engine, air and fuel are mixed together in about a 16 to 1 ratio and rammed into the cylinders. In the turbojet, the air-fuel ratio is 60 to 1. About one-fourth of the air, or oxygen, is burned in the combustion chambers. The rest is used to dilute the mixture to keep temperatures down and to cool the engine's hot components. The oxygen in this unconsumed air of the jet stream supports the combustion of the afterburner.

On paper, an afterburner looks like an easy way to get big thrust dividends from a jet engine. You simply inject gallons of fuel into the jet stream, ignite them and enjoy the tremendous burst of speed which the escaping gases impart. Since the burning takes place downstream from the engine, no added thermal or mechanical stresses are imposed on the critical parts of this highly stressed power plant.

That's the way it looks at first glance. Actually, however, you run into a myriad of paradoxical problems as soon as you begin to get serious with an afterburner design and you never quite get rid of some of them as a good many engineers know from first-hand encounters.

First poser is igniting the afterburner flames. Contrary to expectation, it was found that fuel injected into the hot afterburner did not ignite spontaneously because of the tremendous velocity of the gases. Igniter plugs have to be provided to spark the combustion.

Keeping the flames going and confined within the afterburner is another stickler. For instance, in the British Nene turbojet the velocity of the jet stream is 820 feet-per-second or 932 miles-an-hour. The flame propagation rate of the fuel burned in the afterburner is only 490 feet-per-second or 556 miles-an-hour. Igniting the combustion is like trying to build a bon-fire in a hurricane. The jet stream tends to blow the flames right out of the tailpipe. This obstacle must be overcome, not only to start combustion but also to develop thrust because gases burned beyond the exit nozzle produce no useful thrust.

CONTROLLING temperature is another engineering enigma. Most afterburners will burn substantially more fuel than the jet engines they serve. The Nene afterburner consumes 1110 gallons-per-hour compared with the Nene's consumption of 790 gallons-per-hour at full throttle. Together, they gulp down a whopping 1900 gallons-per-hour or 32 gallons every minute. With such prodigious combustion, temperatures soar and it is desirable that they do because that accelerates gas velocities which, in turn, produces increased thrust. But, with flame temperatures running to 2650° F., and melting points of afterburner metals pegged by nature at 2723° F., it takes careful design to prevent the afterburner from be-

(Continued on page 20)

JET HOT ROD

(Continued from page 19)

coming a blast furnace which smelts itself into a fused mass of metal.

Hand-in-hand with the design problems, which confront the engineers, are the metallurgical hurdles. Afterburners make generous use of cobalt and nickel-base alloys which are rich in these scarce metals. Because some of these alloys are new to production, Ryan metallurgists closely supervise their fabrication. They must be formed quite slowly because they tend to work-harden under rapid forming rates. They have to be annealed at higher temperatures than stainless steels and require special welding and forming techniques. The properties which make them ruggedly resistant at high temperatures also make them more difficult to fabricate.

The basic elements of afterburner designs are the fuel injector, flameholder and adjustable nozzle. Fuel is injected into the swift jet stream through the injector which sprays it under pressure. In one design of the General Electric afterburner, this device consists of a circular stainless steel tube bristling with precision-drilled rods. The fuel flows through these tubes and is sprayed into the jet stream through tiny orifices, aft of the jet engine turbine wheel. For ignition, most designs utilize a specially made spark plug system. To create regions of low-velocity gas and turbulence, so that combustion can be maintained, the afterburner pipe is diverging in cross-section so that the gases can expand, thereby losing speed. A flameholder is located at this point to hold the flame dead center.

Every attempt is made to confine the raging combustion to a specific area, to prevent metal attrition, and to stabilize the burning. After passing the flameholder, the volcanic gases are encouraged to attain maximum velocity because the speed at which they leave the exit nozzle determines the thrust which they impart to the plane.

The mass and velocity of the jet stream is so radically altered by the operation of the afterburner that a means of varying the exit opening area must be devised to maintain a balanced mass flow through the system. The desired objective, with or without afterburning, is to attain maximum thrust commensurate with temperate and pressure limitations. If the jet blast is unduly restricted at the exit opening, excessive back pressures will occur and internal temperatures will rise. If the exit opening is slightly too large, the jet stream velocity will decrease and thrust will drop. These factors are sensitively interdependent and affect each other in an immediate way.

IN the General Electric afterburner, the exit opening is varied by means of an "eyelid" arrangement which is closed during normal engine operation and opened to handle the increased volumes of gases during afterburning.

Most afterburners are fitted with automatic controls which are actuated by pressing a button. This advantage became apparent after a number of starting failures resulted in "hot starts." Caused by the accumulation of fuel, when positive ignition did not occur, these "hot starts" are tantamount to an unwelcome explosion of disturbing proportions . . . rather like letting the gas fumes collect in the gas range before lighting the oven.

With automatic starting, the complete cycle of ignition is accomplished in less than one second without pilot supervision. Eyelid movement is also automatically provided so that these restrictors open when combustion takes place.

An interesting idea, which has been subjected to preliminary tests, is that of introducing the fuel for afterburning ahead of the turbojet turbine wheel instead of aft of it. In this way, the turbine wheel could act as a flameholder and the turbine nozzles would function as atomizers, breaking up the fuel. Because of the natural delay in ignition of 1/1000 to 2/1000 of a second, combustion, with its attendant temperature rise, would not take place until the mixture was several inches past the turbine wheel assembly. This would prevent increased turbine wheel temperature.

If successfully developed, this idea could eliminate one of the main disadvantages of an afterburner by removing the resistance to the jet stream flow which the injector and flameholders present. Also, such a development would permit a much shorter tailpipe, or re-heat pipe, which would be well adapted to high speed aircraft with swept-back wings.

BOEING JET TURBINE

(Continued from page 9)

potent jet engine. They noted that Ryan ball-and-socket joints, an exclusive Ryan development are incorporated in its exhaust system. These universal-type joints are used to isolate movement of the gas turbine from the truck body to which the exhaust system is rigidly attached. Capable of handling large volumes of hot gases, these leak-resistant joints are the same as used in the exhaust systems of Boeing B-50 Superfortresses and other prominent aircraft.

Boeing engineers developed the new gas turbine under contract with the Navy's Bureau of Ships. Currently, engines are being built for the Navy which will use them to generate electric power aboard minesweepers. Although details of the applications are not available, the engine has also been service tested as a power plant for a Navy personnel boat, a Kaman helicopter and a landing craft. Future installation plans include its use in light aircraft, military ground vehicles and as auxiliary power for large aircraft.

The Kenworth truck installation is proving to be a valuable means for service testing the power plant under load conditions. Accumulated road operation for the truck now stands at more than 15,000 miles with over 550 hours of operation on the gas turbine. Data collected shows that fuel consumption, with a 34-ton load, has run slightly better than one mile per gallon of diesel oil.

On the surface, this may appear to be discouraging when contrasted with diesel truck's consumption of from four to five miles per gallon. However, Boeing engineers report that reduction of between 30 and 35 percent in fuel consumption will be accomplished in the near future as a result of successful research on improved compressor and turbine designs.

Another factor which will benefit the application, economically, will be the design of a new truck in which the 3,000 pounds of engine weight saved by the gas turbine will be translated into payload. Then, the gas turbine-driven model will return about the same net to an operator as a current diesel truck.

ADVANTAGES of the Model 502 are numerous. Oil consumption is negligible and maintenance and overhaul costs are greatly reduced over diesel operation. Truck drivers will welcome the new power source because of its smooth responsiveness to control. It accelerates from idling speed to full power in five seconds. It possesses substantially more power for acceleration than the reciprocating engine at any load and cannot be stalled. Operator fatigue is lessened due to the absence of vibration and the simplification of operating procedure.

Inherently, the gas turbine should become a more efficient engine than a steam turbine because it harnesses heat energy directly without employing an intermittent stage in which water is transformed into steam. The gasoline engine overtook the steam engine because it eliminated the heat lost to a steam boiler by bringing the combustion inside of the engine. In similar fashion, the gas turbine may be thought of as an internal combustion turbine, blending the thermal advantages of the internal combustion engine with the vibrationless rotary elements of the steam turbine.

FLYING WAREHOUSE

(Continued from page 11)

power surges because of the inclusion of special Ryan ball-and-socket joints. These universal type joints are located in each header to isolate the engine from the nacelle, as far as movement is concerned, and yet provide a leak-resistant connection for the passage of high temperature gases.

Officers at the Air Proving Ground, Elgin Field, Fla., where the C-124 underwent the most rigorous tests, regard it with great affection. They say that despite its tremendous size and elephantine appearance, it flies as easily as smaller, more conventional transports. One of these officers, 2nd Lt. James D. Atwater, says he likes to think of the Globemaster as bearing a close resemblance to the late Babe Ruth.

Recalling Ruth's powerful shoulders and chest, Atwater comments:

"Like the Babe, its upper body overshadows everything else. And like the Babe in his heyday, the C-124 is the strong right arm of its team."

Airlift has been an American military specialty since it became apparent that as we carried war to remote lands, we would have to maintain a steady flow of supplies over great distances.

Its first dramatic application occurred early in World War II, when passenger transports were converted to cargo use and flown across the Hump between India and China. Airlift became a powerful psychological weapon, as well as a life-and-death necessity, in the postwar Berlin Airlift, when the C-47's and C-54's demonstrated that a ground blockade will not starve a city. And at present, a trans-Pacific airlift is supporting our troops in Korea.

Looking somewhat like a small blimp with wings, the capacious Globemaster II has the cargo area of a five-room house. It contains an LST-type ramp for loading purposes.

Until design of such planes as the Douglas C-74 Globemaster I, handling of cargo had been a matter of improvisation. Most of the transports still in use are conversions of basic passenger transport designs and do not attack this problem with maximum efficiency. There is still too much time lost in loading and unloading, due to narrow doors, inadequate internal space, etc. The type of cargo they can carry is extremely limited. The greatest problems of airlift have not been in the air but on the ground.

In the C-74, loading was speeded by an electric elevator to hoist cargo from ground level to the cargo deck, and an internal electric hoist to move cargo inside the plane. The C-74's began to show the potentialities of efficient airlift by carrying, between the Air Force overhaul base as San Antonio, Tex. and

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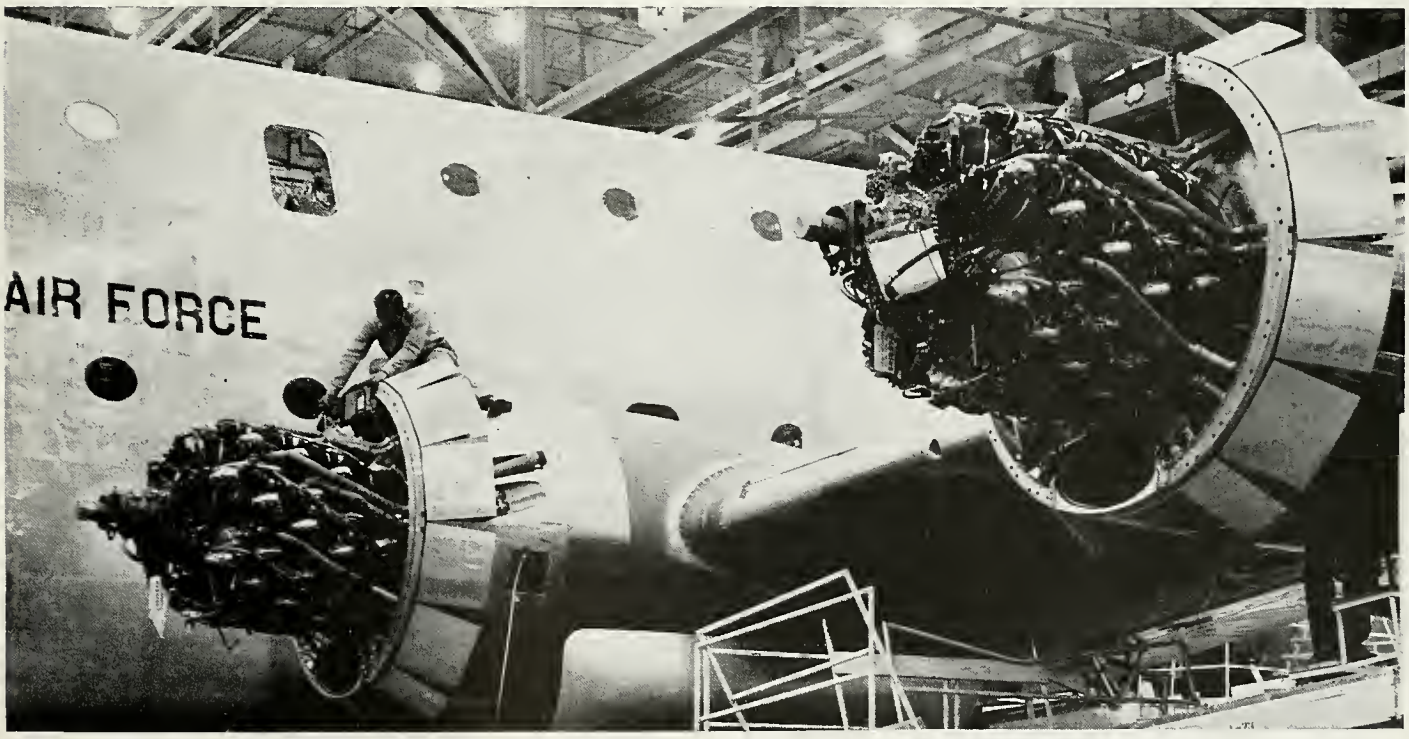


At Douglas' Long Beach plant, Wasp Major engines and Ryan exhaust systems are fitted to the high-lift wings of the Globemaster II.

GLOBAL AIR TRANSPORT

(Continued from page 14)

equal to 6,000 times around the world. In 11,000 round trips over three routes linking the West Coast and Japan, the combined fleet of MATS planes, leased U. S. commercial carriers and U. N. transports, have ferried more than 343,000 passengers and patients —a figure exceeding the entire population of Atlanta, Georgia. Included in this number are 46,000 sick and wounded Americans returned to U. S. military hospitals.

Workhorses of the MATS global air fleet are four Douglas, two Fairchild, one Boeing and one Lockheed multi-engine transport types. Seven of these eight leading military-commercial transport planes are equipped with Ryan exhaust systems, and for one of them—the Boeing C-97 Stratofreighter —Ryan also builds the aft fuselage, cargo doors, floor beams and refueling pod.

The four Douglas transports are the DC-4 Skymaster (C-54 and R5D), DC-6 Liftmaster (C-118 and R6D-1), C-74 Globemaster I and C-124 Globemaster II.

Other key transports, in addition to the C-97, are Fairchild C-82 Packets and C-119 Flying Boxcars, and the Lockheed C-121 Constellation.

The Convair C-131, with rearward facing seats, will soon be added to the air evacuation fleet. Like their commercial counterparts, the Convair 240 and 340 airliners, the C-131's will have Ryan exhaust systems.

MATS was set up June 1, 1948 as the result of a directive issued by the Secretary of Defense consolidating two wartime air transport agencies—the Air Transport Command (ATC) and Naval Air Transport Service(NATS). This marked the first time in U. S. military history that elements of two separate services were integrated into one permanent organization.

Only three weeks after its formation, MATS was called upon to set up the Berlin Airlift. For 15 months, it supplied the beleagured city with 2¼ million tons of supplies—nearly a ton for every man, woman and child in Berlin. This was the first concrete example in history of the use of air transport as a diplomatic weapon.

Today the patterns of MATS routes stretches some 110,000 miles from the Continental U. S. to every point on the globe where American Forces are stationed and where U. S. interests lie.

Bases or detachments are maintained in such places as Newfoundland, Iceland, Bermuda, the Azores, Tripoli, Saudi Arabia, India, Pakistan, and the Philippines, as well as in Europe, throughout the Caribbean and across the Pacific. The hundred thousand MATS personnel are located in 37 countries.

MATS primary mission is to maintain a flexible air transport capacity for strategic inter-continent and inter- theater airlift. The swift and timely movement of critical material and personnel is a vital link in the logistical support of American combat forces.

Latest figures for the Pacific, Atlantic and Continental divisions show a total of 572 transport aircraft assigned, of which about 345 are four-engined types. MATS also has 415 other types, such as helicopters, and amphibians for rescue work, specialized weather reconnaissance planes, and trainers.

MATS support of NATO air transport requirements is one of the command's top priorities. The Atlantic is flown either by way of the Azores or the northern route via Keflavik, Iceland. Earlier this year, MATS pilots started ferrying jet fighters to Europe unescorted by lead transport planes.

Actually MATS responsibilities go far beyond air transport. Various air route support services have been placed under its control:

Air Weather Service (AWS), which charts and forecasts world-wide weather conditions.

Airways and Air Communications Service (AACS), which handles the transmission of weather data and flight traffic communications.

Air Rescue Service (ARS), which supplies rescue facilities to both military and civilian aircraft all over the world.

Flight Service (FS), which monitors all military flights and coordinates them with civilian flights and air defense.

Air Resupply and Communication Service (ARCS), which provides air resupply for isolated detachments.

Air Photographic and Charting Service (APCS), which is responsible for the overall photographic needs of the Air Force, including training films and still and motion picture coverage of combat operations.

Without these highly professional and experienced services, which are available to all U. S. and some allied agencies, air traffic volume, safety and dependability would be difficult, if not impossible. The services have been placed under MATS in order to produce a cohesive, compact and economical administrative and operational entity.

During its four years operation, MATS has gained invaluable experience, adding greatly to that reservoir of air transport know-how handed down by its famous World War II forebears, ATC and NATS.

More importantly, two outstanding achievements—the Berlin Airlift and the Pacific Airlift—have demonstrated the vital importance of air transport in the overall needs of modern warfare.

Maj. Gen. Joseph Smith, one of the original planners of the Berlin Airlift, became commander, MATS, last November. His vice-commander is Rear Adm. Hugh H. Goodwin, a Naval aviator since 1929, who has been associated with the command for over a year.

$7 Million in New Contracts Signed By Ryan

New orders totaling $7,000,000 for airframe parts and aircraft engine components have been received by Ryan Aeronautical Company in the past month, according to T. Claude Ryan, president.

With deliveries currently running at approximately $3,000,000 per month, the new business resulted in a net gain of $4,000,000 in the backlog of unfilled orders on hand, which now stand at more than $70,000,000.

Largest of the contracts closed was with General Electric for additional quantities of aft frames, transition liners and inner combustion chambers for J-47 jet engines.

From Boeing Airplane Company substantial orders were received for C-97 fuselage parts; exhaust systems for B-50 bombers and C-97 cargo planes; and jet engine tail pipes and external fuel tanks for the B-47 Stratojet.

Other major contracts are with Continental Motors Corp, for exhaust manifolds for M-48 tanks, latest versions of the famed General Patton model; and with Douglas Aircraft Company and Consolidated Vultee for exhaust systems for commercial and military transports.

Completing the $7,000,000 new order list were contracts from Canadair and Aeronca for exhaust systems for Beech's new twin-engine T-36 trainer and from Piasecki for exhaust systems for helicopters.

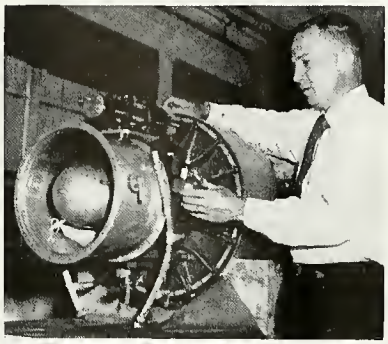
JETS JOIN RYAN RESEARCH

Dramatically bracketing the research which Ryan engineers are accomplishing in the jet engine field are two recent arrivals to the jet test cells. The smaller power plant, a Turbomeca Marbore II, is one of the smallest turbojets in actual use. Manufactured in France, it has been licensed for U. S. fabrication by Continental Motors. It produces 880 pounds of thrust and possesses a surprising power-to-volume ratio which is better than most of the announced military jet engines.

Contrasted to the tiny Turbomeca, the Allison J-33 is a mighty giant of packaged power. Developing 5400 pounds of thrust, with water-alcohol injection, it has accumulated a vast number of flight hours in Lockheed, North American and Grumman aircraft. It was the first jet engine to pass the 150-hour type test.

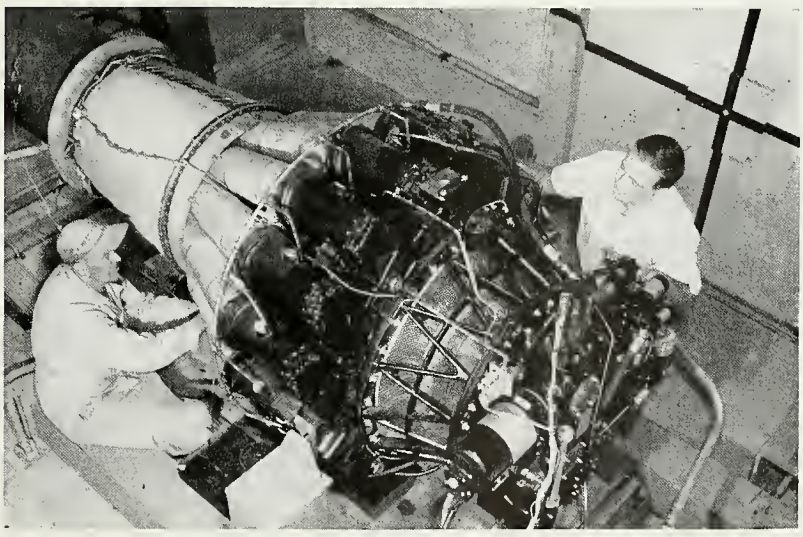
Although details of the work cannot be revealed, because of military restrictions, Ryan engineers are using these power plants in important research projects under experimental contracts. Now cloaked in secrecy, these investigations will add substantial knowledge to the fields of high speed and elevated temperatures in which Ryan excels.

Another type of jet power plant which is getting a lot of attention from Ryan engineers is the rocket engine. Under contract with Aerojet Engineering Corp., Ryan is building tiny rocket engines which will release an unbelievable blast of power to help send missiles soaring into space. Capable of attaining the highest speeds, rocket engines are the only power plants which can operate without depending upon the atmosphere.



Tiny, but powerful, Turbomeca jet engine gets scrutiny by Forrest Warren, Jr., Ryan project engineer.

Unlike conventional engines, turbo-jets, ramjets and rockets are largely sheet metal power plants which must be fabricated from carefully prescribed alloys. The hurricane of heat which they generate is not contained in a heavy cast structure but is bottled in thin-walled chambers which must stand up to terrific temperatures. Ryan's years of experience in designing and building high temperature exhaust systems for piston engines is proving invaluable in meeting the challenge of these jet-type power plants.



Charles Jensen, test cell mechanic and Edward Sly, Ryan engineer ready big Allison J-33 jet engine for special test program of undisclosed nature.

PURGING REVEALED

(Continued from page 7)

neer; B. W. Floersch, chief chemist; and R. K. Preece, John Baxter and J. C. Fischer, flight test plans, data reduction and reports.

Flight operations have been conducted not only at San Diego but at Edwards Air Force Base, Muroc, California. The mechanical crews have been headed by J. B. Key, assistant foreman, and Fred Haywood, inspector. Installation and test mechanics at San Diego were A. F. Gradischer, Aurin Kaiser, Murray Wick and Lee Walker.

At Muroc, James Burney was in charge. Other Ryan personnel there were Fred Musterer and Robert Bruce, engineers; Walter D. Cannon, Jr., inspector; Robert W. Hart, welder; and J. L. Conklin, J. F. Detloff, Curtis Franklin, Kenneth E. Hunter, Bobby E. Miller and Edward W. Pye, installation and test mechanics.

FLYING WAREHOUSE

(Continued from page 21)

the overseas maintenance base at Burtonwood, England, 25-ton loads of Pratt & Whitney engines used on the Berlin Airlift C-54's.

But the C-74 still had many drawbacks in ground handling of cargo. These have been overcome in the C-124 Globemaster II, which has been aptly referred to as a "flying LST."

The usable internal space was increased to 10,400 cubic feet in a squared fuselage which gives it a waddling, "ugly duckling" appearance on the ground. Trucks and trailers can fit these contours. The cargo area is equivalent to the space of an average five-room house.

In the nose was installed the type of loading ramp used in an LST, which rises and lowers mechanically through clamshell nose doors wide enough to accommodate any type of motor vehicle from a jeep to a truck to a 25-ton Walker Bulldog tank, one of the Army's newest. Range and payload characteristics vary from 25 tons for 2,100 miles to 5 tons for 6,000 miles.

For troop carrying, a light magnesium second deck folds down into place to provide facilities for 200 fully equipped soldiers or 127 litter patients. Compare this with the capacity of 38 troops or 29 litter patients in the C-54 (military counterpart of the DC-4), and you get an idea of the Globemaster II's tremendous size.

The flight deck is a world apart—

(Continued on page 24)

three stories up inside the plane. The cockpit is so high the crew must slide down an aluminum pole to the bottom deck to reach the bail-out door. With the maximum fuel load the C-124 carries 11,000 gallons or more than a railroad tank car. Lt. Atwater reports that the C-124 "rides air currents like the Queen Mary taking an ocean swell."

The important thing to remember about the Globemaster II is that it can carry cargo as a whole, whereas even in the C-74, bulky objects such as the Walker Bulldog tank had to be stripped down and put back together again at destination.

"The gaping maw of the Globemaster II swallows everything whole," Lt. Atwater says. "Hours no longer are wasted breaking down equipment and lifting it through narrow doors in fuselages set high off the ground."

A spectacular example of delivering cargo ready to go into immediate use was afforded by a Globemaster which was still undergoing tests at the Air Proving Ground in Florida. An emergency had arisen in Korea, requiring immediate delivery of one of the new ten-passenger Sikorsky H-19 helicopters to fly in supplies and take out casualties from small airfields in the rugged terrain. The Globemaster solved the problem with dispatch. The whole H-19 was simply rolled up the long ramp through the nose and into the cavernous belly. Three days later, the H-19 was unloaded in Japan. The next day it flew to Korea and went into action.

This is the kind of special delivery that will enable Globemasters to lift an entire division of 16,000 combat troops from the east coast to France within 24 hours. The division's heavy equipment, such as gasoline trucks, maintenance and radar trailers, truck-mounted cranes, 155 mm. Long Tom artillery pieces, 240 mm. howitzers, light tanks, weapon carriers, standard trucks and jeep can all be easily loaded for prompt delivery into the field.

Little wonder that the Air Force admires the clumsy-appearing body that can out-lift more graceful companions.

"Like the ugly duckling, this aircraft has a doubtful parentage, combining features of a parking lot and an LST with the body of an airplane," Lt. Atwater declares.

"It leads much the same life as the individual who isn't too good looking, but has a terrific personnality." Virtue is its own reward. The C-124 bears the remarkable distinction of being the least sworn-at aircraft in the Air Force."

WORKERS SHOULD HAVE CHOICE

(Continued from inside front cover)

movement has taught me that compulsory unionism in any form — Closed Shop or Union Shop—is totally wicked and totally unnecessary. I know from practical experience that unionism can be sold strictly on its merits and does not have to be forced down the throat of any worker not yet prepared to accept its advantages. I further know that any man who becomes a member of any organization against his own free will seldom makes a good member and does more harm than good to the cause. . . .

"Your argument concerning the so-called "free rider" on the "gravy train" of unionism is by no means a sound one. You assume that everything the union does is bound to be of benefit to the worker. On this point I most emphatically disagree and for the following reason:

"Too many labor leaders believe that what they secure under contract is the maximum of what the worker should receive. The assumption may be true in the case of the least competent worker but it is anything but true in the case of the superior—or even the average—worker.

"For example: The bricklayer who is capable of laying 1200 bricks a day is being compensated on the basis of his fellow worker who is able to lay only 400 bricks a day. In short, the "gravy train" in this instance can refer only to the incompetent worker, for he—because of his incompetency — under union contract penalizes the man who is fully capable.

"A union philosophy based on the premise that competence and incompetence should be rewarded on one and the same scale smacks of socialism—and socialism, if allowed to gain a firm foothold in American industry, can only wreck all enterprise. Unionism operating as socialism in disguise becomes no "gravy train"—at least to the millions of workers possessed of personal initiative and a spirit of real enterprise. As honest, hard-working Americans, these workers must simply not be herded, by means of the Union Shop, into organizations not of their own choice. . . ."

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HIGH TEMPERATURE METALLURGY

(Continued from page 17)

any known material. The pure metal still has an ultimate tensile strength of 100,000 psi at 1600° F.; 15,000 psi at 3500° F.; and 10,000 psi at 5000° F. Incidentally, the temperature of a glowing lamp filament is 4500° F.

But, tungsten's affinity for oxygen is so great that it cannot be used, unprotected, for high-temperature applications. Similarly, other high melting point metals, such as molybdenum, columbium, zirconium and tantalum, all have too much affinity for oxygen to be used without special protection in these applications.

Molybdenum's melting point is around 4800° F. and its short-time strength at elevated temperatures runs between extremes of 40,000 psi at 1500° F. to 26,000 psi at 2400° F. But, it oxidizes rapidly in air above 1200° F. and at 1800° F. it evaporates through oxidation at the rate of from .020 to .050 inches per hour.

Molybdenum can be protected by surrounding it with helium or hydrogen or, recently, by coating it with mo-silicide precipitated on its surface from a gas phase. Protected molybdenum has been used for over 5000 hours in air at 1800° F. and as long as 300 hours at 3100° F.

The large number of alloys developed and tried for high-temperature applications fall into two general classifications —the Hastelloys, which have a nickel base, and the Stellites, with a cobalt base. The Hastelloys, of which Multimet is an example, have a molybdenum content of from 16% to 30%, tungsten from 3.75% to 5.25%, iron from 4.5% to 7% and the balance of nickel.

The Stellites are very useful in the 1400° F. to 1800° F. temperature range. At 1400° F., they have a creep strength of from 17,000 to 30,000 psi. Highest tensile strength of any metal among this group is exhibited by X-50 whose creep strength at 1600° F. is 52,000 psi. Most

(Continued on page 25)

of them show good resistance to scaling up to 2000° F. These alloys have been generously used in jet engine parts, such as rotating blades, and in the sheet metal components which Ryan builds, such as combustion chambers, transition liners, inner and outer exhaust cones, tailpipes and structures for rockets, ram-jets and pulse-jets.

ABOUT 1800° F. seems to be the limit of applicability and usefulness for these alloys, with present knowledge. It, therefore, seems that further development must lead into the field of ceramics. The main shortcomings of metals are lack of resistance to oxidation and chemical attack at high temperatures. Ceramics, on the other hand, are extremely resistant to oxidation, because they are saturated oxides of metals, and often are resistant to corrosion.

Ceramic coatings as a means of protecting metals from heat and corrosion have long been known—in cooking utensils, sinks and bathtubs. However, high-temperature applications in aircraft require more stringent specifications. Their thermal expansion coefficient over the temperature range contemplated must be as close as possible to that of the metal to which they are bonded. Coatings must also be very thin, to save weight, and very resistant to thermal shock.

In addition to applying the ceramic by dipping or spraying, the most recent method is by vapor deposition. Volatile compounds, containing the coating elements, are passed over the work pieces which are heated to a temperature above which the components of the vapor react. In most cases, they decompose and are deposited to form the desired coating. Such coatings can prolong the life of the coated parts at operating temperatures, permit their use at higher temperatures or allow the use of lower alloy metals in the application.

In considering bodies made entirely of ceramics, a radical change in design of the part is necessary if it is substituted for one of metal. Ceramic bodies are non-ductile and present problems where mechanical shock and stress concentrations are present. They have no definite melting point but deform gradually at elevated temperatures under stress.

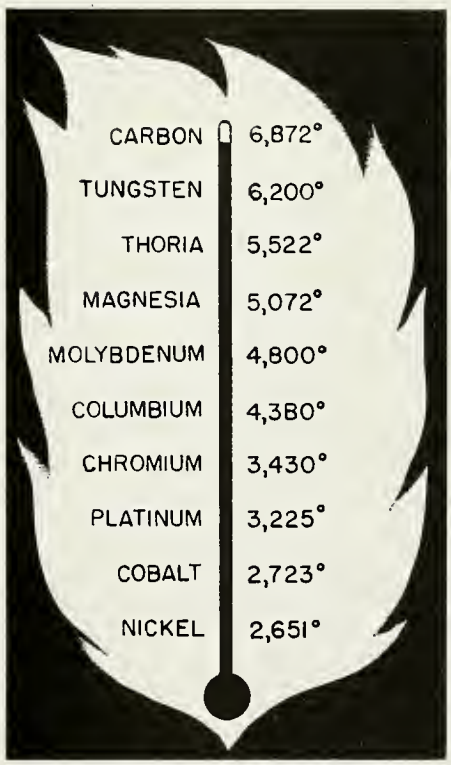
Raw materials for manufacture of ceramic bodies include alumina; zirconia, stabilized with lime or unstabilized; beryllium oxide, lime, magnesia; thoria; the carbides of titanium, silicon, boron, zirconium; carbon and graphite. This field is a highly confidential one in which these materials are used both singly and in mixtures.

Alumina is cheap, stable, pure and not affected by reducing conditions even at highest temperatures, but its melting point (2050° C.), is lower than many refractories. Its thermal conductivity is high and it has no inversion points in its expansion curve.

Beryllia has a melting point of 2570° C., excellent resistance to thermal shock and high heat conductivity, but mechanical shock strength is inferior to alumina.

Zirconia, found in sands up to 97% pure, presents great processing difficulties. It undergoes crystal inversions which cause large and abrupt volume changes, is very sensitive to thermal shock and melts at 2680° C.

Magnesia, a good insulator, melts at 2800° C., is stable under oxidizing conditions, but easily reduced in atmospheres above 2300° C. It has the highest coefficient of expansion of all refractories.



MELTING POINTS IN DEGREES FAHRENHEIT OF SOME HIGH TEMPERATURE MATERIALS.

Thoria has the highest melting point (3050° C.) and the greatest density of all ceramics. Manufacturing difficulties are encountered because of the high firing temperatures necessary for vitrification.

The carbides have high thermal conductivity, good thermal shock resistance and good hot strength but most of them are unstable at high temperatures.

Carbon and graphite surpass all other materials in resistance to softening at elevated temperatures. Pure carbon has no melting point but sublimes at 3450° C., while graphite melts at 3800° C. Both soften above 2000° C. Although their mechanical strength is low, their excellent resistance to oxidation and corrosion justify their use as guide vanes in rockets.

THE most frequently used method in manufacturing these super-refractories is molding and hot pressing in graphite dies, but pressure is limited by the strength of the graphite, which is less than 5 tons per square inch. Die temperature is kept at 5400° F. Strength, thermal conductivity and corrosion resistance depend upon porosity of the fired body and the properties approach a maximum as porosity approaches zero.

No one refractory has all of the properties necessary. Zirconium carbide is the strongest at 2200° F., but its resistance to oxidation is poor. Boron carbide has the poorest thermal shock resistance. Titanium carbide has excellent resistance to thermal shock and good resistance to oxidation. Zirconium boride is capable of withstanding the highest temperatures and seems very promising.

As far as ceramic materials, alone are concerned certain properties characteristic of metals cannot be obtained. This has led to the combining of metals and ceramics in the manufacture of metal-ceramics by powder metallurgy methods. The rather low thermal and mechanical shock resistances of ceramics can be expected to be improved by mixing refractory metal powders, such as tungsten or molybdenum, with their metalloidal type compounds, such as oxides, borides, carbides, etc., and pressing and sintering them. In this process, the chemically resistant ceramic particles surround the ductile metal power particles, thus giving the material ductility and resistance to high temperature and chemical attack.

Powder metallurgy has great potentialities in the development of heat-resisting super-alloys for extremely high temperature applications. However, the use of such super-alloys will mean that we will have to change our production methods. Forging and casting at the temperatures at which the materials will eventually be used—and then expecting such materials to retain their shape and exact dimensions during use is, per se, a contradiction.

Only those materials can be expected to perform satisfactorily which have very high melting and boiling points and which soften at considerably higher temperatures than those at which the part will be used. Because of the unlimited number of combinations possible and because grain size, purity and inherent porosity can be better controlled, powder metallurgy techniques offer better possibilities for fabricating super-alloys than conventional manufacturing methods.

RYAN AERONAUTICAL COMPANY
P. O. BOX 311
SAN DIEGO 12, CALIFORNIA

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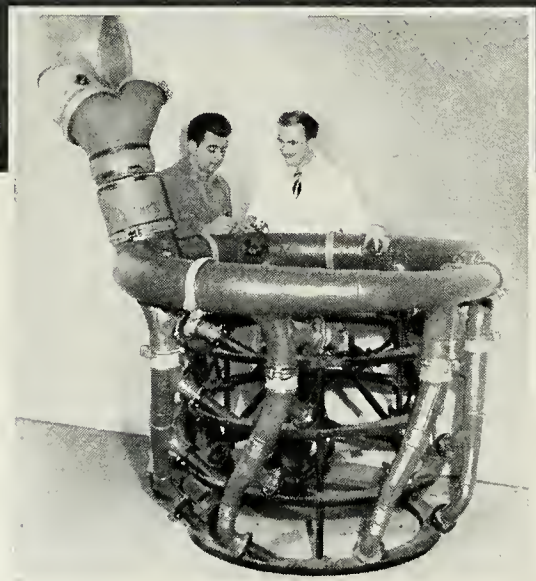
Aircraft and Aeronautical Products

Leaders in High-Temperature Metallurgy

for

JET, PISTON AND ROCKET ENGINES



In fabricating stainless steel and other heat- and corrosion-resistant alloys, Ryan's leadership has been established by proved techniques and long experience in this specialized field. With ceramic coating, continuous metallurgical research, and development of new alloys, Ryan is extending its research toward substitution of less critical materials for jet, piston and rocket engine components.

Typical of Ryan's high-temperature developments is this ceramic-coated exhaust system for Boeing Stratocruisers. The first company to put ceramic-coated engine parts into production, Ryan has proved they are highly successful in inhibiting corrosion and carbon absorption, thereby extending service life. Now ceramic coatings are available for jet engine components, too.

Ryan SINCE 1922

Metal Products Division • Jet Engine Components • Exhaust Systems • Rocket Assemblies

RYAN AERONAUTICAL COMPANY • LINDBERGH FIELD • SAN DIEGO, CALIF.

Ryan REPORTER

foreword

THIS special issue of Ryan Reporter is a historical document, covering thirty of the fifty years since Orville and Wilbur Wright changed the course of history at Kitty Hawk, North Carolina, December 17, 1903.

True, this chronicle tells but a small part of the whole story of Aviation's Fifty Golden Years. Yet the history of the Ryan organization and its founder-president, T. Claude Ryan, is typical of the history of American aviation.

It is equally typical of what this great country has offered to those individuals and organizations who have kept their eyes on opportunity, rather than on security, as a goal. The Ryan company's success has been more than one of personal and group accomplishment; it has contributed much to San Diego, much to the welfare of the thousands of workers to whom this plant has long been a better place in which to work and earn a livelihood.

The Ryan story is one of broad diversification, with major pioneering contributions in many fields of aviation endeavor.

In these pages we look at the many facets of Ryan activities today and in the past thirty years—at its interest in military planes, in scheduled air transportation, high-temperature metallurgy, basic aeronautical research and development, in personal planes, training, in pilotless aircraft, rocket engines, airframe components manufacture, guided missiles and in many other fields.

Today, as in the past, Ryan has many assets not shown on its financial statement. In the words of George C. Woodard, executive vice-president, who wrote them five years ago when the organization reached the quarter-century mark:

"The experience, abilities and morale of an organization—its people—its workmen, engineers, supervisors and managers—are the all-important intangible assets that cannot be price tagged. They represent a basic value greater than all the inventories, buildings, machinery, cash and other tangibles which the company possesses.

"Ryan people have skills and abilities made extra fine by years of experience with their company. This did not just happen nor could it have been accomplished overnight. It is the direct result of years of building on sound principles and policies.

"Through necessity, your company has demonstrated the versatility and persistence required to meet constantly changing conditions. It has grown steadily through booms and depressions.

"Its sinews have been toughened, its judgment seasoned and it is set to continue and add to its record of success. Such is the spirit of your company, the Ryan organization."

That spirit burns as brightly on this Thirtieth Anniversary.

THE EDITORS

contents

Here, then, is The Story of RYAN and

		Page
AIR TRANSPORTATION	*"Progressing With Air Transport"*	2
ITS MILITARY PLANES	*"From Prop to Jet"*	6
PRODUCTION LEADERSHIP	*"Applied Know-How"*	11
THE COMPANY'S GROWTH	*"We've Never Stopped Growing"*	16
AIRFRAME COMPONENTS MANUFACTURE	*"Manufacture of Airframe Components"*	19
HIGH-TEMPERATURE METALLURGY	*"Answer to Red Hot Problems"*	22
ITS PLANES AT WAR	*"Ryan Planes at War"*	27
PORTRAITS OF ITS PLANES	*"Ryan Plane Portraits"*	31
RESEARCH AND DEVELOPMENT	*" R & D"*	42
HOW IT ALL STARTED	*"His Dreams Took Wings"*	47
PERSONAL PLANES	*"Private Flying Is Good Business"*	50
TRAINING ACTIVITIES	*"Fledgling Wings"*	53
ITS OLD-TIMERS	*"The Pioneering Ten"*	56

Close liaison is maintained by Ryan engineers with transport aircraft manufacturers on exhaust systems installation and servicing. Technicians from Ryan's Metal Products Division are shown here conferring over system for Convoir 240.

WHEREVER giant transport planes span continents or oceans, Ryan goes along—in the "hottest" accessories for their powerful engines.

Like sterling is to silver, the name "Ryan" is to exhaust systems. For more than 15 years, the company has been the principal supplier of rugged, heat-resistant, easily maintained exhaust systems for the world's most famous multi-engined transports.

Ryan's partnership with transport manufacturers and the airlines in this respect dates back to the "granddaddy" of modern airliners, the time-honored, reliable Douglas DC-3. Well over 50,000 exhaust systems for DC-3 Pratt & Whitney engines were produced by Ryan, and provided such satisfactory service that Ryan exhaust systems almost automatically became the equipment for the DC-4s and more currently all models of the DC-6s.

Today, large quantities of complex exhaust systems are also being produced for other distinguished commercial transports—including the Convair 240 and 340, and the Boeing 377 Stratocruiser.

The byword is constant improvement to increase trouble-free service life, which now runs into thousands of hours for each type of Ryan-built system. At bases in many parts of the world, Ryan service engineers assist

PROGRESSING WITH AIR TRANSPORT

CONVAIR — Among most modern transports equipped with Ryan exhaust systems are Convair 240s and newest 340s, shown below, now being produced for United and other airlines thruout world.

BOEING — Giant Boeing 377 Stratocruiser is one of the many distinguished planes powered by engines with Ryan systems to carry off extremely hot exhaust goses.

25 — Movie personalities helped T. Claude Ryan, right, celebrate start of nation's first regular daily ssenger service, named "Los Angeles-San Diego Airline."

1925 — First of the world-famed series of Douglas transports was this open-cockpit, eight-passenger Cloudster, which was acquired by Ryan and converted into a ten-passenger, single-cabin plane for airline.

commercial airlines and the Military Air Transport Service in overhaul and maintenance problems.

Ryan's interest in air transportation actually was one of the cornerstones of the company's varied enterprises. When T. Claude Ryan set himself up in business exactly 30 years ago this month, he acquired a war-surplus "Jenny" for $400, and began taking up adventure-loving San Diegans on sightseeing flights.

The business grew as tourist buses made regular stops at the Ryan field. The flight equipment was expanded from the original "Jenny" to a fleet of six Standard open-cockpit, two-place biplanes reclaimed from a war-surplus warehouse in Texas and converted by Ryan into five-place enclosed cabin planes that provided a hint of the interior arrangements of transports of the future.

Thus equipped, Ryan searched farther afield and decided that income from his sightseeing activities, frequent charters to Los Angeles, and flight instruction possibly could be augmented by a daily scheduled passenger service between San Diego and Los Angeles. The "Los Angeles-San Diego Airline" was inaugurated March 1, 1925, and became the first regularly scheduled year 'round passenger airline in the United States. One round trip was made daily in a Ryan-Standard; flight time was 1½ hours each way, and the fare was $17.50 one way, $26.50 round trip. With one passenger a day each way, the venture would break even, Ryan figured. (Today's flight time is about 45 minutes, and the round trip fare is about $17, including tax).

Ryan's advertising extolled the wonders of traveling by air. "From the beginning of time, advancement in civilization has been marked by improvement in methods of transportation," a Ryan Airlines, Inc., folder gushed.

"The inauguration of Airway Service reveals the most perfect form of travel known to man."

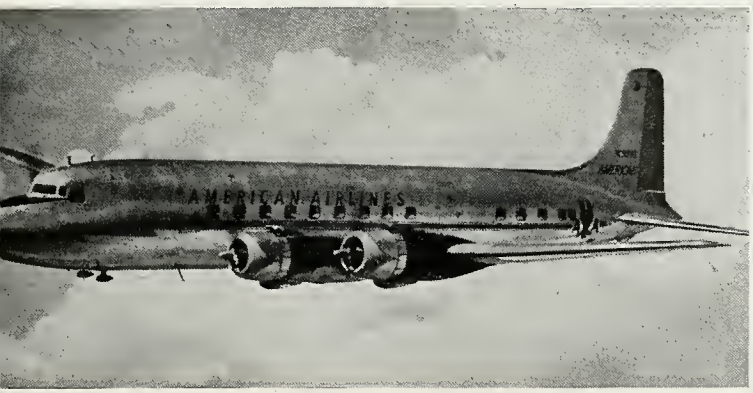
As for this particular airline, the literature assured prospective passengers that "the company's rigid system of plane inspection and maintenance, and the employment of only the best pilots and mechanics, is ample assurance of safe and delightful trips."

Enthused over the prospects of air transportation, Ryan later in 1925 acquired the first plane built by Donald Douglas, the Cloudster, the forerunner of the world-famed series of Douglas transports. Again a remodelling job was necessary, and the Cloudster was changed from an eight-passenger plane with three open cockpits to a single cabin accommodating ten persons, with space forward for pilot and mechanic or co-pilot. This was certainly one of the first "modern" airliners in the United States.

By now, Ryan had acquired a considerable reputation as a pioneer in air transportation, but he was dissatisfied with essentially improvised equipment. The government now was

(Continued on next page)

DOUGLAS — All Douglas DC-6 transports, such as those used by American Airlines, have Ryan collectors, using the jet thrust exhaust system to augment plane's speed.



1926 — Survey flight by Vern C. Gorst, l., and T. Claude Ryan in M-1 from Los Angeles to Seattle was foundation of United Air Lines' Pacific Coast route.

1927 — The M-1 and its successor, the Ryan Brougham, became the most popular early-day transports in America, especially after Lindbergh's transatlantic flight in a Ryan-built monoplane. The first M-1's went to Gorst's Pacific Air Transport, a $500,000 company which had been awarded government contract to carry the mail.

planning to turn its airmail service over to private contractors, and Ryan found this an ideal opportunity to put into practice a long-held theory.

He had always believed that a monoplane would provide a cleaner, more efficient design than any of the biplanes in common use then afforded. Ryan was certain he could improve on the de Havilland biplanes which had been employed by the Post Office Department.

His brainchild was the M-1 (M for mail; 1 for first), destined to become the first volume production monoplane in America. The basic design, as laid out by Ryan, called for a high-wing three-place monoplane powered by a Wright Whirlwind 200 h.p. air-cooled engine. Other power plants offered were Hispano-Suiza (150 h.p.), Super Rhone (120 h.p.) and Curtiss OX-5 (90 h.p.). Compared to the 400 h.p. D-H mail plane, the M-1 carried 50% more load and cruised 20 mph faster on half the power. The M-1, Ryan was certain, would furnish greater speed, durability, load carrying ability, and would be easier to produce and maintain than the current biplane.

Literature on his new plane even pointed out, "the wing is above the heads of the people, thus saving damage to lower biplane wing when passengers step through it in climbing into cockpits."

The first M-1 was being assembled at the Ryan field on Dutch Flats, north of San Diego bay, when an Oregon bus line operator, Vern C. Gorst, appeared on the scene, attracted by Ryan's "know-how" in air transportation.

Gorst knew very little about aviation, but he was organizing a $500,000 company, Pacific Air Transport, and was aiming at the air mail contract for the Pacific Coast route.

When Gorst appeared at the Ryan hangar seeking advice on how to get started, the conversation probably went something like this.

Ryan: "Do you have a pilot's license?"

Gorst: "No."

"Do you know anything about flying?"

"The only time I've ever been up was in one of Glenn Martin's pontoon-equipped 'Flying Birdcages' back about ten years ago—in 1915."

"Well, it's a cinch you can't run an airline unless you know something about planes. Hop in."

Whereupon Gorst, who came to get some information about airline operations, stayed to learn how to fly.

And it was Ryan, with Gorst as passenger, who made the epochal survey flight in an M-1 over the airmail route between Los Angeles and Seattle that proved the foundation of United Air Lines' present west coast system. The plane not only cracked all flight records between cities on the route, but handily defeated the Army's "hottest"

1926 — Literature outlining virtues of M-1 told of its superiority over current biplanes. Greater speed, durability, payload were cited in brochure.

1926 — M-1 monoplanes went into "mass" production, as 23, remarkable for that year, were built. Mail plane pictured was bought by Colorado Airways.

1927 — Air transport owes its greatest early debt to Charles Lindbergh and his Ryan monoplane. The world was truly air-conscious after his famous flight.

plane, the de Havilland of Lt. Oakley Kelly, hero of the first nonstop transcontinental flight. It was a match race at the Army's Vancouver, Washington, base, and it caused quite a sensation. Ryan's faith in the monoplane design was thoroughly vindicated.

Gorst was awarded the air mail contract, and his Pacific Air Transport became the first of several airlines to order M-1s. In the first year of quantity production, 23 were turned out—a remarkable number for any one factory in the 1920s.

Well established in the transport field, the M-1 was constantly improved. Its successors included the "Bluebird," first of the Ryan Broughams, which were to pioneer air line routes in Latin America, Canada and Alaska, as well as in the United States.

The Brougham had another distinction—it proved the basis for the design of Lindbergh's "Spirit of St. Louis," built in the Ryan plant for an unheralded airmail pilot who was attracted by the renown of the Ryan mail planes. Lindbergh's trans-atlantic flight enhanced popularity of the Ryan Broughams, and gave them worldwide recognition.

Another phase of Ryan's interest in air transportation was ushered in after World War II, when hundreds of business men began to accept as "strictly routine" the use of their executive planes for personal air travel—travel in most cases for practical reasons.

In 1947, Ryan interest in air travel expressed itself with acquisition from North American Aviation, Inc., of the design and production rights to the four-place, all-metal Navion. Here, for the first time, was a plane with the speed, comfort, safety, carrying capacity, ease of flying and ability to operate from improvised landing fields, which made regular use of a business plane practical and profitable.

Many of the businessmen owners of Ryan Navions use their planes as company-owned "airliners" on almost regular schedules, knitting together their far-flung interests.

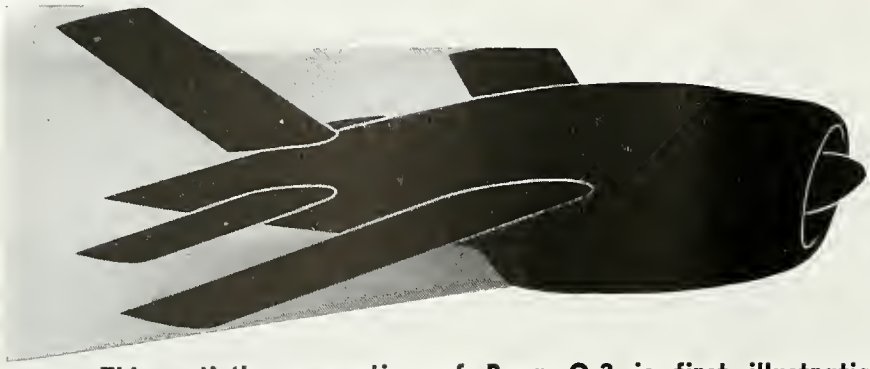
A typical example would be the contractor in Minnesota who purchased a Navion for regular "commuting" between his contracting operations, Texas citrus ranch and Nevada gold mine—3000 miles covered often within two or three days.

In some countries . . . Iran is a good example . . . where traffic density so far has not justified larger airplanes, Ryan Navion Super 260s carry the mail to remote towns which would otherwise be isolated for weeks at a time from means of rapid communication.

The Navion is truly a transport, hauling all kinds of goods, equipment and machinery, as well passengers, in emergency or special situations.

Although Ryan's interest in air transportation now is centered about its exhaust system production for large planes (the Navion program having been suspended during the present defense emergency) the company will always maintain a favored spot in its long-range planning for the type of aircraft that carry people and things long distances swiftly and most efficiently.

1949 — Among the brightest stars of modern private air transport is the Navion, which is used by business and professional men, and corporations all over the world. Typical example is the fleet pictured above. It is owned by Executive Fleet, Inc., and its four Navions are available for special trips by Connecticut businessmen.



FROM

Q-2— This artist's conception of Ryan Q-2 is first illustration of jet-propelled pilotless target plane released for publication.

HIGH above the desert sands of New Mexico a small pilotless jet airplane streaks across the sky at near sonic speed, guided only by the hand of a grounded "pilot" at a remote-control panel.

It is Ryan's new Q-2 target drone designed for anti-aircraft and aerial gunnery training and for use in combat plane interception problems by Army, Navy and Air Force units.

Little has been written or can now be revealed of its design details beyond the bare description that it is less than half the size of modern American jet fighters, but with comparable performance. Of 14 proposals submitted by leading aircraft manufacturers, the Ryan high-speed target design was selected for development, limited production and flight test evaluation.

Currently, Ryan has other Air Force and Navy projects under development, but details are, of course, not releasable.

The first germ of the idea that the Ryan organization might someday build military planes probably passed unconsciously through T. Claude Ryan's mind one day in March 1926 when he picked up a copy of the "Portland Oregonian."

The previous day at the Army's nearby field, Ryan had flown his company's new M-1 monoplane in a match race against top Army pilot Lieut. Oakley G. Kelly in a souped-up military DH-4 biplane, and won.

The news report read:

"Here's the answer," said Lieutenant Kelly at the end of the flight. "Here's my machine with a 400-horsepower motor with less speed than Ryan's with a 200-horsepower motor. My machine was built by the government in 1917 and Ryan's was built this year."

"I'm dragging around a lot of struts and wires that aren't necessary in the modern planes. In other words, the Army needs some new machines to keep up the pace with private and commercial owners."

It wasn't until 1939, however, that the Army Air Corps purchased its first Ryan military planes—three experimental XPT-16 low-wing, metal fuselaged primary trainer versions of the popular S-T, followed by a service test quantity of thirteen YPT-16s.

Actually, the air forces of Mexico, Honduras and Guatemala, in 1937 and 1938, were the first to order Ryan STM military trainers. These were all powered with 150 h.p. supercharged in-line Menasco engines, since at Mexico City, especially, operations were from high-altitude fields.

AIR RACE STAGED AT PEARSON FIELD

T. Claude Ryan Defeats Lieutenant Kelly.

BIG ARMY PLANE DISTANCED

Officer Declares Military Airship Outclassed.

NEW VEHICLES WANTED

400-Horsepower Liberty Engine Unable to Pull Craft Fast as Small Machine Goes.

VANCOUVER, Wash., March 21.—(Special.)—T. Claude Ryan, flying the Ryan M-1, a monoplane and the

PT-20 — First low-wing primary trainer ever used by Air Force was earlier PT-16 version of popular Ryan S-T.

MILITARY TRAINERS

In 1939 the U. S. Army began preparations for expanding its training plane program by using the facilities of commercial airplane manufacturers. Fifteen companies were invited to participate in flight competition. Ryan, with a military version of its 125 h.p. Ryan STA was one of the three winners. In the Ryan PT-16, the Army got its first low-wing primary trainer, which was a major departure from a 30-year precedent of using only biplanes for initial instruction of aviation cadets.

Ryan's position in the competition was no mere chance result. The plane already had four years of training experience under its belt. Its original design was the result of Claude Ryan's own Army Air Corps training plus 12 years instructing commercial pilots. In its modern design, the S-T incorporated all the qualities felt most necessary for proper pilot training.

That the PT-16s more than met the Army's expectations was evidenced by orders placed a few months later for a

PROP TO JET

far larger number of Ryan PT-20 trainers, which incorporated some engineering revisions, principally wider cockpits.

America's allies, too, needed advanced type military trainers and Ryan was soon in production of export versions of the PT-20s. Known as STMs, hundreds of these planes were shipped overseas in 1940 and 1941 for use by the Chinese Air Force and Netherlands East Indies Air Force.

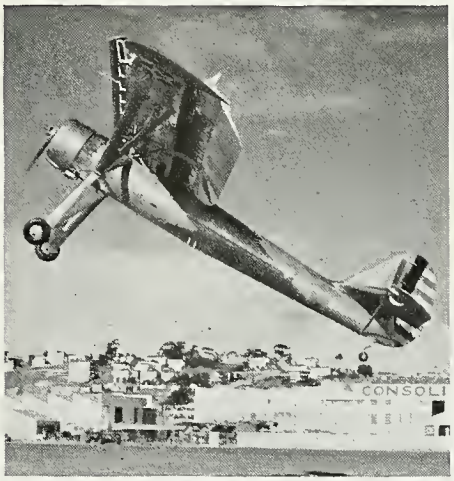
Another model, the STM-S2 seaplane trainer with twin floats, was developed and supplied to the Dutch East Indies Navy. After the outbreak of war in the South Pacific, many of the Netherlands Indies trainers were shipped to Australia and used there by the Royal Australian Air Force.

STM-S2 — Twin floats converted land-based trainers to seaplane used by Navy pilots of Dutch East Indies.

DRAGONFLY

While production of the STM trainers for China was under way, Ryan received a new assignment from the U. S. Army —for the development and limited production of an experimental short-range liaison observation plane.

This was the sensationally performing Ryan YO-51 "Dragonfly." It was capable of virtually hovering while in flight.



YO-51 — "Dragonfly" was spectacular observation plane capable of landing and taking off at steep angles.

It made unbelievably quick take-offs at seemingly vertical angles and short, steep landings never previously obtainable with a fixed wing type airplane.

The Dragonfly attracted wide attention because of its unique aerodynamic qualities and it proved the designing and engineering capabilities of the Ryan organization in fields other than military trainers.

Construction of the Dragonfly was unique for its unusual lift-increasing wing devices. It incorporated slots along the entire leading edge and a Fowler-type flap along the entire length of the trailing edge. Ailerons were incorporated as part of the flap structure.

The Dragonfly was able to take off and clear a fifty foot obstacle within 350 feet, and could maintain a minimum flight speed of 32 miles an hour while holding a chosen altitude. The slots and flaps so increased the lift and drag as to reduce the landing speed to an absolute minimum, and to increase to a very sharp degree the gliding angle.

MORE TRAINERS

Continuing the expansion of its training plane program, the U. S. Army asked Ryan to design and build a new military primary trainer plane of more advanced design, incorporating improvements suggested as the result of extensive experience with the PT-20s.

In September, 1940, the Army ordered 200 PT-21 (ST-3) trainers, powered this time with a Kinner 132 horsepower radial engine in place of the earlier in-line Menasco power plant. The United States Navy also placed orders for 100 of these planes, known as NR-1s.

The basic contract was soon increased to call for 600 PT-22 trainers to be powered by 160 h.p. Kinner engines. Then shortly after Pearl Harbor an additional 450 PT-22s were ordered. Under Lend-Lease, 100 of these were sent to China.

As Ryan neared the end of its production program on PT-22s, the Army placed an unusual order in asking that a limited number of the 22s be equipped with floats for seaplane operation. These ST3-S seaplane trainers were delivered

(Continued on next page)

PT-21 — An improved version of PT-20, hundreds of these trainers were ordered by the Air Force and Navy.

PT-25 — Revolutionary new plywood plane was developed by Ryan early in World War II when Air Force sought to overcome critical aluminum shortage. Except for engine cowling, virtually all strategic materials were eliminated. Several were built for service tests before metals scarcity eased and production was terminated.

to the Army and took part in a secret mission which was never revealed.

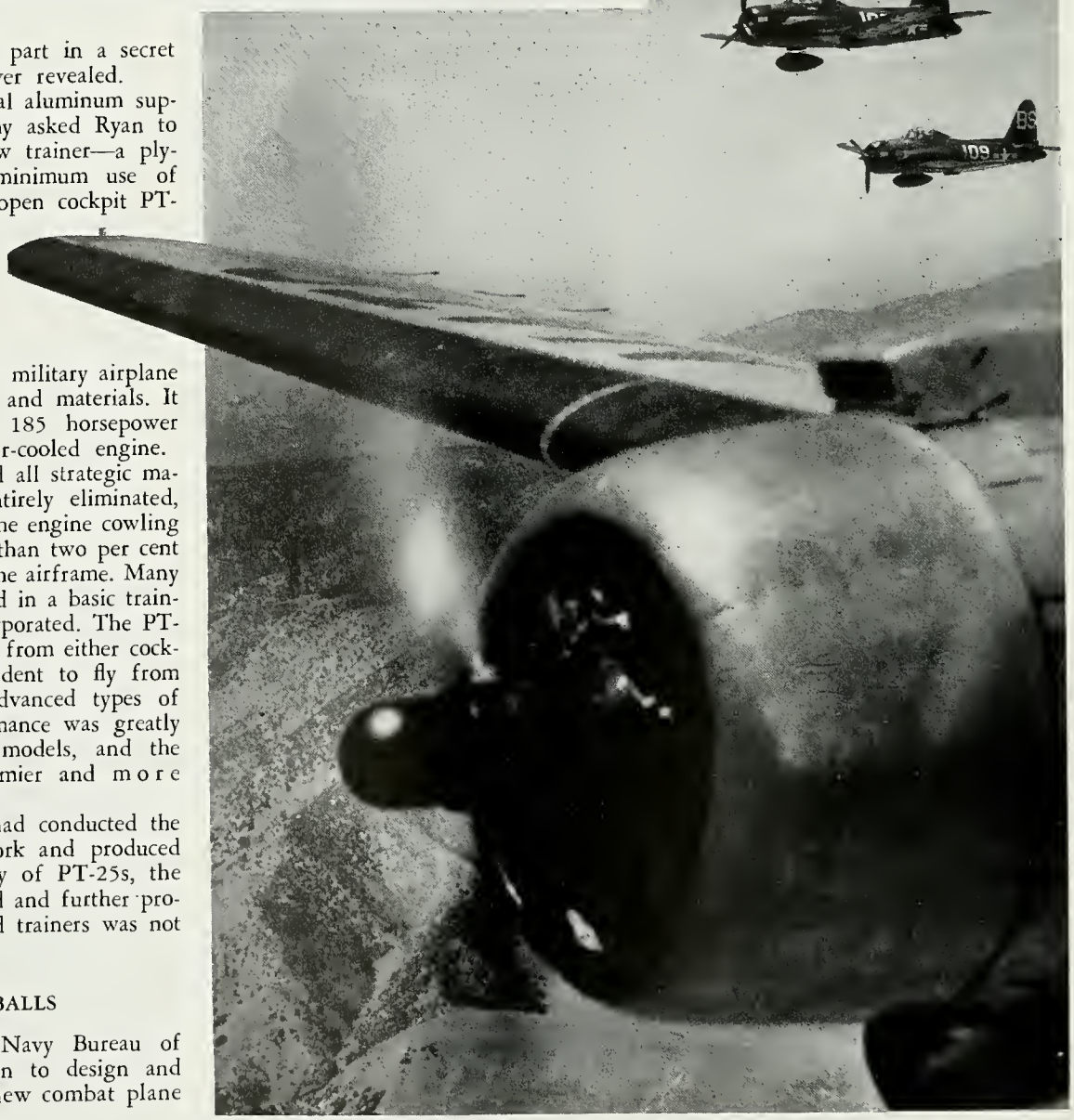
Because of the critical aluminum supply in 1942, The Army asked Ryan to develop an entirely new trainer—a plywood plane making minimum use of metals. The two-place open cockpit PT-25 was an entirely new military airplane in design, construction and materials. It was powered with a 185 horsepower Lycoming 6-cylinder air-cooled engine.

Aluminum alloys and all strategic materials were almost entirely eliminated, with the exception of the engine cowling which represented less than two per cent of the total weight of the airframe. Many of the qualities required in a basic training airplane were incorporated. The PT-25 could be flown solo from either cockpit, permitting the student to fly from the front as in all advanced types of military flying. Performance was greatly improved over other models, and the cockpits were far roomier and more comfortable.

By the time Ryan had conducted the initial development work and produced a service test quantity of PT-25s, the aluminum scarcity eased and further production of the plywood trainers was not undertaken.

THE FIREBALLS

In late 1942, the Navy Bureau of Aeronautics asked Ryan to design and produce the FR-1, a new combat plane



FR-1 — This spectacular photo, taken from Navy transport plane in foreground, shows a formation of four Ryan FR-1 Fireballs speeding along with props feathered. It's not an optical illusion; the jet engines in aft fuselage make flight possible.

able to operate from small escort carriers. For peak performance it would combine the advantages of jet propulsion—most efficient at high altitudes and high speeds —with a piston engine and propeller for the short takeoff and long cruising range necessary for aircraft carrier operation.

The Ryan Fireball was not only the first plane in the world to combine reciprocating engine power with jet propulsion, but was also the Navy's first jet airplane. The Japanese surrender, however, came before the Fireball got into combat, though an evaluation squadron was in operation.

The Fireball had many unique characteristics. It could be operated on either its jet engine alone or the conventional power plant only, but for peak performance the two power sources were used together.

Because its conventional engine was most efficient for take-off and at lower altitudes, and the jet engine most effcient at higher levels and speeds, performance of the Fireball on both engines was extremely high at all altitudes. It was the most maneuverable of fighters and had the highest sustained rate of climb. In short, the Ryan Fireball fighter had an excellent combination of desirable fighter plane characteristics.

Although the Navy's first fighter to use jet propulsion never saw combat, the Fireball has secured an important place in Naval Aviation. Knowledge gained from its manufacture and performance was immediately translated into improved Fireball designs as well as utilized in developing other new planes.

The original jet-pushed, propeller-pulled FR-1 Fireball was powered with a 1300 horsepower Wright Cyclone R-1820 piston engine, turning a propeller, and a 1600-pound thrust General Electric I-16 jet engine in the aft fuselage.

To pioneer the use of turbo-prop engines for the Navy, Ryan modified a standard FR-1 by substituting a General Electric TG-100 "prop-jet" engine for the conventional piston engine in the nose. Known as the XF2R-1 "Dark Shark," the shark-nosed all-turbine fighter had far more formidable performance. It was the first Navy plane, and the second of any type in the United States, to be powered by a gas turbine engine turning a propeller.

Still another version of the composite-powered Fireball was the XFR-4 which had the conventional Wright 1300 horse-

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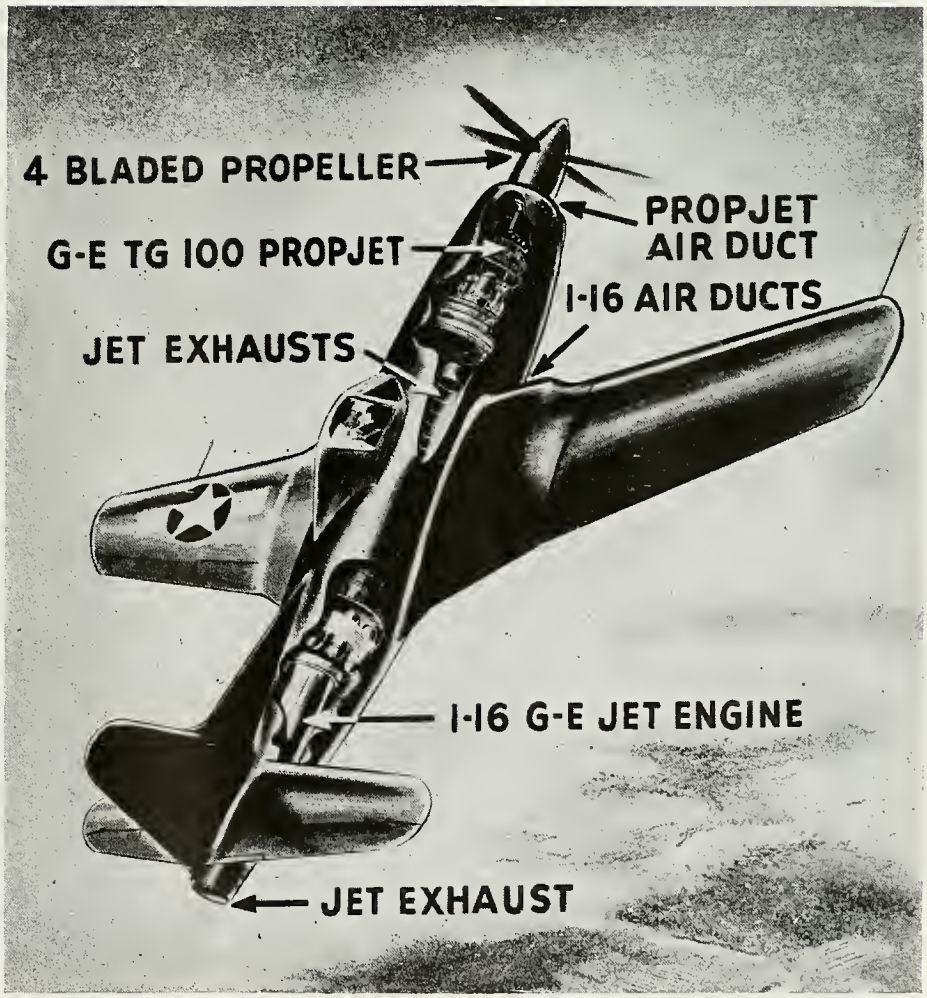
RYAN Fireball Fighter



XF2R-1 — By substituting a turbo-prop engine for the piston engine in the nose, Ryan further pioneered for the Navy in development of this "Dark Shark" all-jet fighter, with greater performance characteristics than the FR-1 model Fireball.

power piston engine up front but a larger jet engine aft—this time a Westinghouse J-34 (24-C) of 1900 pounds thrust.

The General Electric TG-100 (of the XF2R-1) and the Westinghouse J-34 (of the XFR-4) with a Ryan afterburner added, were to be combined in a new Fireball configuration. This ultimate development in jet-plus-propeller design was designated XF2R-2. Post-war funds for engine development were so drastically cut, however, that the Navy had to abandon production of the turbo-prop engine and with it the Super Fireball.

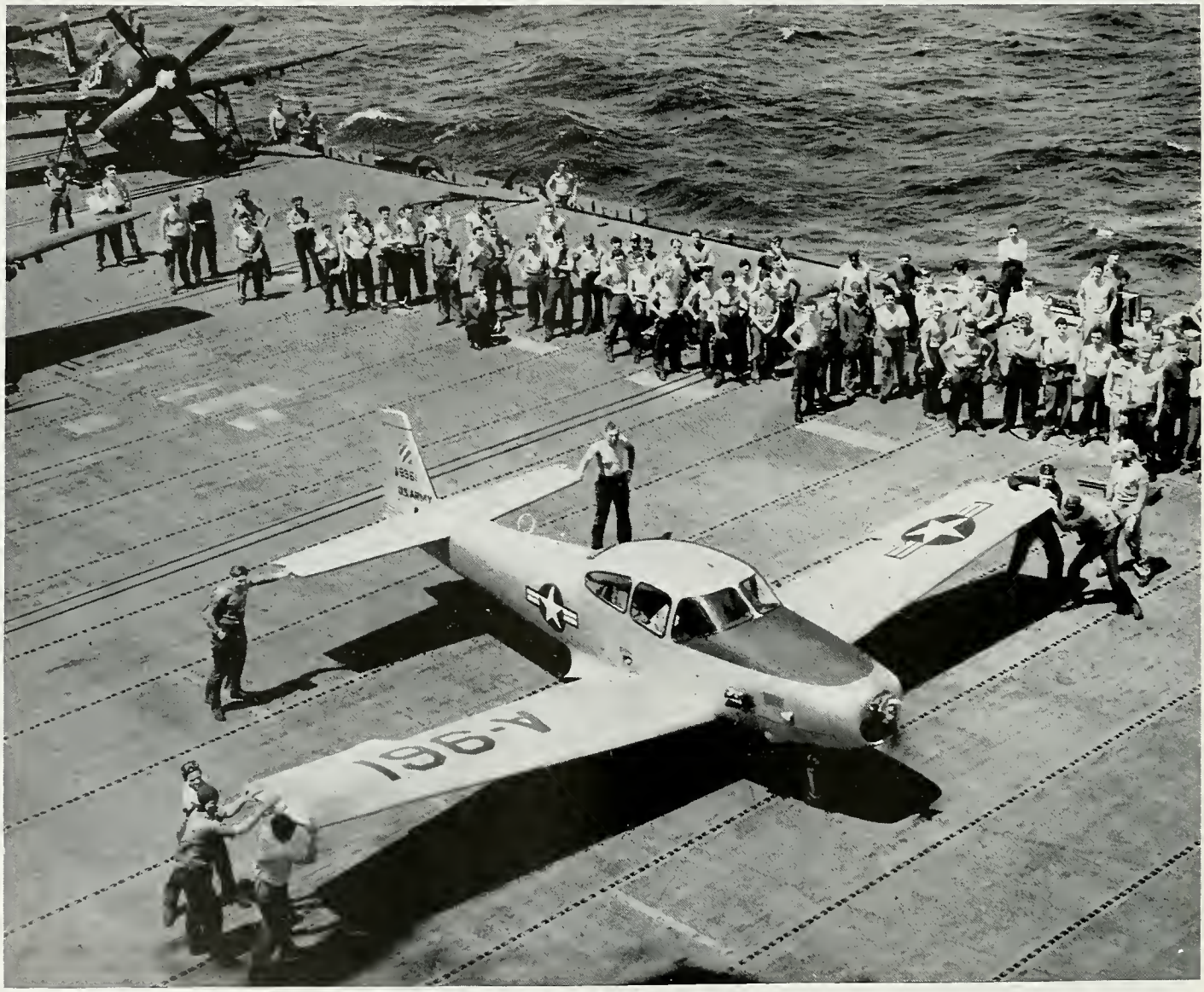
RYAN NAVIONS

Navion L-17B liaison planes, so successfully used in Korea, are the most recent Ryan military model on which detailed information can be published. Based on an original North American Aviation design, all rights to which Ryan acquired in 1947, the Ryan Navion L-17B is a multi-purpose workhorse of the Army Field Forces and National Guard.

Procured "off-the-shelf" with no special expenditure for new design, the L-17B is the military version of the four-place, all-metal commercial Ryan Navion, so extensively used for business flying. Approximately 250 L-17s are in use in Korea, Japan, Europe and South America. Of these, approximately 80 are L-17A models produced by North American. They are powered with a 205 h.p. Continental engine and cruise at 150 m. p. h.

They have had wide service in Korea where they have received high praise for the excellent flying characteristics, efficiency in operating from short, r o u g h fields, and proven ability in light transport missions, aerial reconnaissance, artillery spotting, fighter plane target direction and the transport of field commanders.

Though a number of new Ryan military planes are either flying at test bases or are in the early stages of development, details are not releasable. Included among these is a challenging project for the Navy Bureau of Aeronautics, as well as the Ryan Q-2 target aircraft.



L-17 NAVION — "Jack of all-trades" is this military version of famed Ryan Navion commercial plane used extensively for business flying. It has even taken off from aircraft carriers, as shown in above photo in Korean waters. About 250 are in use in Korea, Japan, Europe and South America. Rugged construction and efficiency in operating from short fields make it valuable for light carga, reconnaissance, artillery spotting, fighter plane target direction, and field commanders' transport.

JET PARTS PRODUCTION — Stainless steel canes for aft frames of G.E. jet engines, flow from Ryan's jet assembly building. Specially designed welding machines make the gas-tight longitudinal seams in these closed parts.

APPLIED KNOW-HOW

FEW companies can point to the variety of production which Ryan has encompassed in its 30-year span of activity. From pilotless target drones to jet engine parts; low-wing trainers and personal planes to deadly jet fighters, and ramjets to rockets, Ryan production has run the gamut.

Through the years this manufacturing effort has flowed along two broad highways. One of these, the Airplane Division, has produced complete airplanes and aircraft components from gleaming sheets of aluminum alloys. From the other, the Metal Products Division, high temperature exhaust systems and jet engine components have been fashioned from tough, heat-resistant stainless steels. In both types of fabrication, Ryan production experts have devised specialized techniques for improving production.

If Ryan ingenuity were to be symbolized by a single industrial process, that process is welding. Long before the light metals could be welded, and aircraft were completely riveted affairs, Ryan was performing prodigious amounts of welding of stainless steels for exhaust systems.

The star performer of welding at Ryan is spot welding. Little used until comparatively recently, except for non-structural components, spot welding is now assuming a stellar role in the fabrication of Ryan components. With 75 modern machines, the industry's greatest array, Ryan is using spot, seam and roll-spot welding to perform remarkable tasks.

Best examples of this are the huge Ryan fuel tanks which are primarily spot welded structures. Largest external aircraft tanks in the world, these mammoth containers are joined together with 30,000 invisible, weightless nuggets of cast metal. Designed for spot welding from their inception, they are exceptionally light-weight, yet can carry record-breaking quantities of fuel. The huge spot welding machines, upon which they are built, were especially designed for Ryan production requirements.

By ordering these machines with prescribed electronic controls and operating mechanisms, Ryan can utilize them to exceptional advantage. With wheel-type electrodes, the machines will make a series of overlapping spot welds, to form gas-tight seams. The wheels can be rotated to perform longitudinal seam welding, for work on closed cylinders, as well as circumferential. By simple conversion, the welding machines can be adapted to roll-spot welding. This Ryan specialty employs a fast, intermittent wheel action which makes up to 140 spot welds a minute with accurate spacings up to 1⅞ inches.

Ryan has pioneered in the use of "spot-tacking"—a rapid method for assembling parts into perfect alignment prior to fusion welding. In this innovation, widely-spaced spot welds are used to "stitch" the parts together much like a garment is basted for final sewing.

Boosts in welding rates have been accomplished by Ryan methods engineers in the conception of multiple-electrode welding machines. Feasible for long run production, these versatile machines can make as many as twelve spot welds, simultaneously. They usually serve a dual function as efficient alignment jigs.

In the field of fusion welding, Ryan has also pursued a vigorous course of de-

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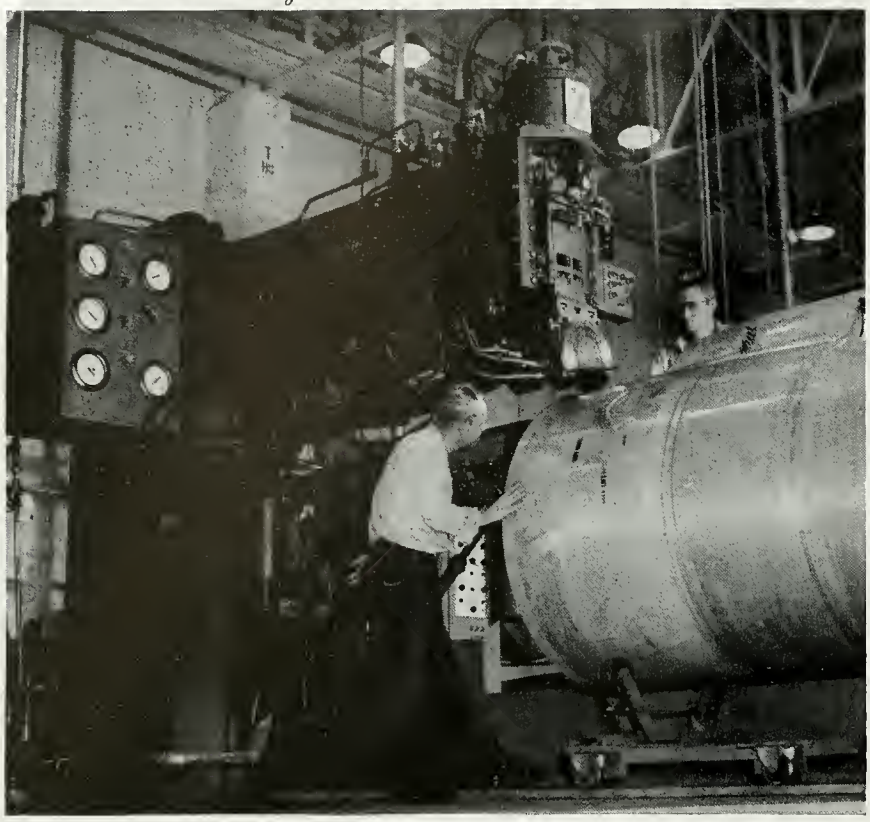
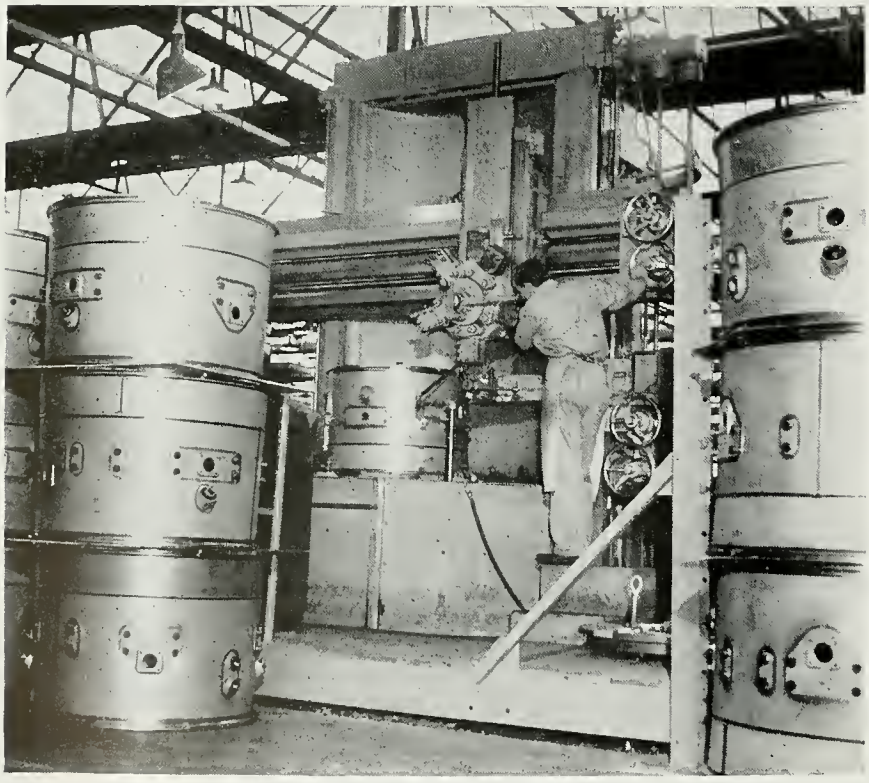


ELECTRIC WELDING — Towering over Phillip Zeigler and Rogert Ogier, the mammoth Federal seamwelding machine is one of eight used at Ryan in big fuel tank program. These are among the country's largest.



BIG LATHE — Surrounded by gleaming jet engine cones of stainless steel, Charles Kotlan watches the fast-whirling table of Ryan's big Bullard vertical turret lathe. The West's tallest, it can machine 7-foot parts.

velopment and utilization. During World War II, Ryan was one of the first manufacturers to convert facilities to atomic hydrogen welding of light-gauge stainless steel work.

The emergence of heliarc welding, in recent years, has proved so superior to atomic hydrogen that Ryan has again converted a large part of the arc welding facilities to this method. Welding under a flow of inert gas, this process makes possible the successful fusion welding of aluminum and magnesium. Ryan has installed large automatic machines for welding both stainless steels and aluminum alloys with heliarc. These machines achieve better welds than human hands can perform. They are electronically controlled to make perfect welds with unbelievable speed and quality.

The latest version of the inert gas welding machine is the Sigma welder. This equipment employs a consumable electrode rather than the tungsten type and is extremely fast. With it, Ryan is welding exhaust system flanges of stainless steel in one-fifth the time formerly required.

Of course, the man behind the metallic arc welding torch is still doing an important job at Ryan. Light, simple and flexible, this type of manual welding is admirably suited for welding fittings and reaching inaccessible locations. Sixty percent of the welding performed on Ryan exhaust systems and jet engine components is arc welding. Consequently, Ryan is one of the nation's largest users of small diameter welding electrodes.

Unlike many plants building a single product, such as an automobile or refrigerator, Ryan fabricates a number of different products in widely varying quantities. Also, Ryan is both an assembler and manufacturer and, in some production lines, accomplishes both functions concurrently. Consequently, methods engineers play an important role at Ryan by fitting facilities and parts together in the most efficient production patterns.

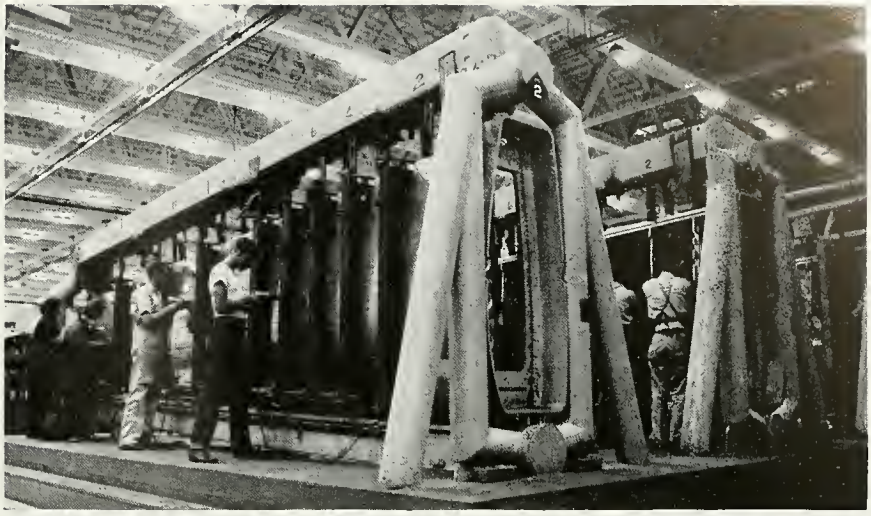
To build thousands of exhaust systems for the Continental engines of the famous General Patton tanks, Ryan has utilized an idea from the food industry. A 140-foot motorized belt conveyor system was installed and the production of these parts tailored to fit this straight-line flow pattern. The new belt has saved forty percent of Ryan's valuable floor space for this project and brought parts volume up to contract requirements.

In another type of fabrication, the manufacture of large stainless steel exhaust systems for Pratt and Whitney 3500

horsepower aircraft engines, Ryan has developed an entirely different production line. This system consists of four contiguous areas, each served by individual conveyor systems of mobile dollies rolling on continuous tracks. Dollies and storage racks are keyed to machines so that a balanced control is maintained in building the seven different components which form each complete exhaust system.

Ten years ago, as the complexities of manufacturing began to multiply, Ryan devoted intensive study to the question of efficient production patterns. At that time, the Ryan "flow production" system was introduced. This method is based upon the idea that exhaust systems fabrication is more like the garment-making industry than any other and borrows several features from it. Both produce innumerable models and sizes of the product with the same equipment. Ryan determined that highest efficiency could be attained if the various machines were placed along logical parts flow lines in sequence, as far as possible, rather than grouping similar machines together.

One way in which Ryan production has been advanced is by the work of the development laboratories in creating new, improved welding fluxes. The Ryan "backing" flux was developed to weld thin sheets of stainless steel by providing a support for the molten weld metal. Another Ryan flux was designed to protect the chromium, in stainless steels, so that it would not oxidize at elevated welding temperatures. In 1945, Ryan produced the first brazing flux which made possible the furnace brazing of stainless steels with zinc-free copper alloy.



JIGS — Designed on the "milking stool" principle, Ryan fabrication jigs are suspended upon only three points so they can be quickly aligned upon uneven floors. Welded, tubular steel construction provides maximum rigidity.

Ryan production is concerned with a variety of products, many of which are designed to function in the unexplored regions of high temperatures. This type of fabrication demands the closest liaison between laboratory and production lines. The Ryan development laboratories have consistently provided valuable resource to the factory.

In addition to controlling all chemical and physical processes in the plant, the laboratories have contributed many new manufacturing procedures. For instance, during World War II, the development laboratories saved huge sums annually by devising a new salt bath furnace for stress-relieving welded stainless steel parts. Employing sodium carbonate, in molten form, this new bath cuts the stress-

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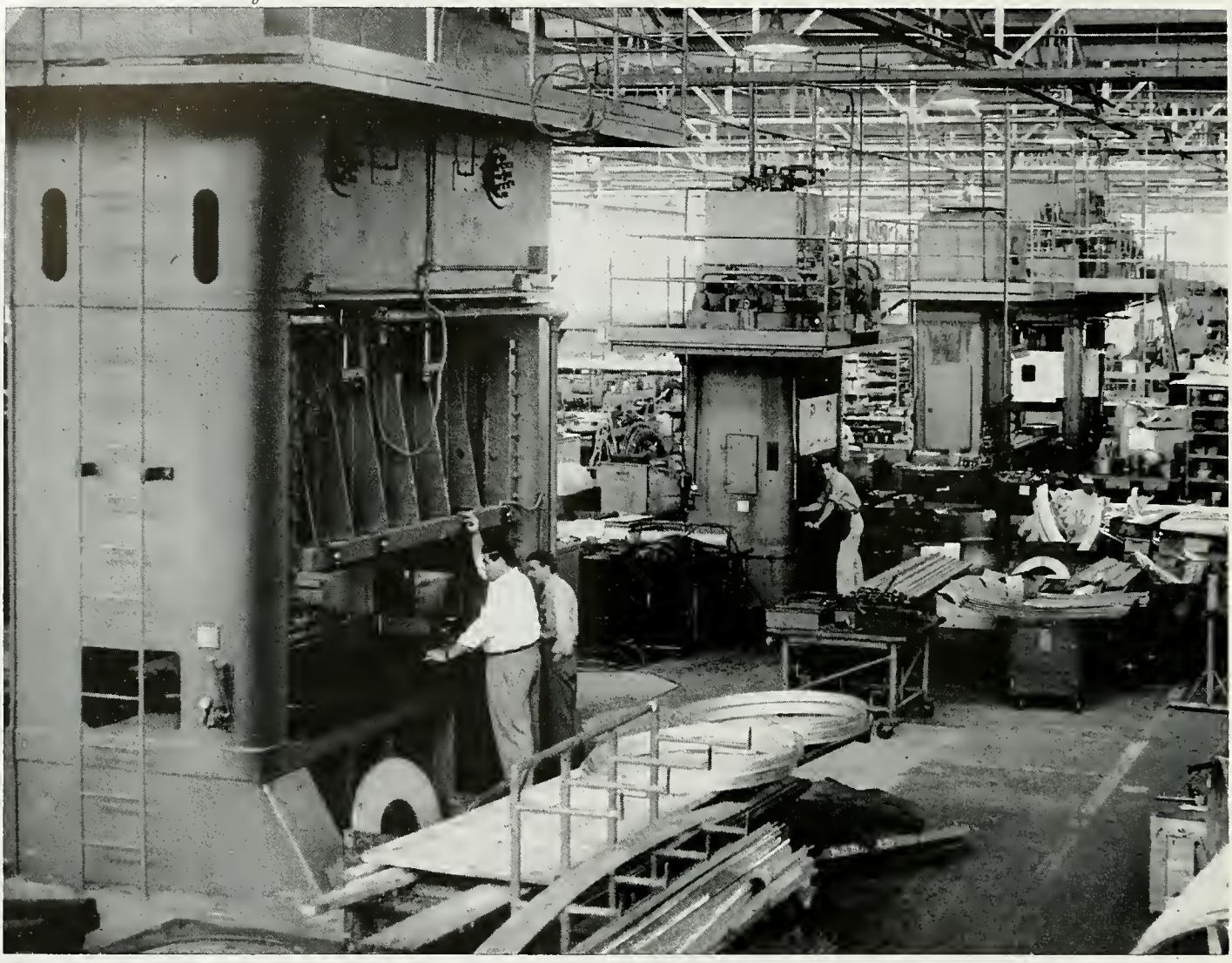
BELT CONVEYOR — With a 140-foot moving conveyor line, Ryan methods engineers bring General Patton tank engine manifolds to employees in uniform flow. The innovation steps up production and saves forty percent of floor space.



BIG PRESSES — **In Ryan's "press room" twenty-five metal crushing giants put the squeeze on stainless steel and aluminum to form aircraft structures. Trend is to huge presses which can stamp out whole assemblies like cookie-cutters.**

relieving time from 59 to only 15 minutes.

On another occasion Ryan was faced with a serious problem with the introduction of 19-9DL stainless steel and Inconel parts into production. The standard hot nitric-hydrofluoric acid bath, effective with 18-8 stainless steel, proved to be inadequate in removing furnace scale from the newer alloys. After a swift investigation of the situation, the laboratory's chemists developed a new descaling sequence which produces a bright finish on all three types of alloy with a minimum of handling. As a result, it was possible to step up the tonnage of parts through the pickle baths by 400 percent and to reduce sandblasting operations, an expensive process, by 75 percent.

The development laboratories have conceived numerous chemical compounds which have attracted attention throughout industry because of their successful application. Designated "RACO" compounds, these new formulae are developed in response to specific factory requirements. RACO 220 was conceived to remove surface stains from 24ST Alclad aluminum alloy without reducing the thickness of the pure aluminum cladding. Applied to the large surfaces of the Boeing C-97 aft fuselage sections which Ryan builds, the solution is polishing the metal without abrading the protective coating.

RACO 34 was evolved to permit the spotwelding of a new un-clad aluminum alloy used in the fabrication of mammoth Ryan fuel tanks. When none of the commercially available cleaning compounds would clean this alloy with the uniformity required by structural spotwelding, the development laboratories began their search. The result has been RACO 34—an excellent cleaning agent which removes all oxides with smooth uniformity. Because this tank project is the largest production effort attempted with this particular alloy, the creation of this compound has been a significant step forward.

In producing complete airplanes—the Ryan PT-20 series of trainers, the FR-1 Fireball jet fighter and the Navion executive plane—Ryan created full-scale production lines similar to the familiar aircraft practice. Most of the planes' parts were fabricated in Ryan's 40-acre plant. These components were brought together

in the huge final assembly building and mated on large rolling fixtures. As each jig moved to the end of the steel tracks, a new Ryan plane rolled out of the massive doors on its landing gear.

An interesting technique, involving a 17,000-pound camera, was developed by Ryan for aiding the construction of airplane prototypes. Laboratory chemists devised a solution which bonds photographic emulsion to almost any material, including steel, aluminum, plastic, glass, wood and so on. By coating sheets of metal with this emulsion, engineering plans for a new airplane can be reproduced directly upon them. Then, the sheets can be formed, drilled and trimmed and fabricated into an experimental aircraft. Thus, the time-consuming and costly necessity for making steel templates and cutting out parts from them is eliminated.

Soon after moving into the present plant, in 1939, Ryan perfected the three-point suspension fixture and adapted it throughout the factory. Constructed from heavy, tubular steel and suspended upon only three points, the jigs can be maintained in alignment even though floor levels change. This was particularly gratifying when jigs were moved because they can be plumbed quickly on uneven floors.

Ryan has always designed and built a substantial number of fixtures and special tools for production. With their use, relatively unskilled personnel can often perform work of exacting dimensions. As manufacturing tolerances have shrunk, with jet engine requirements, these precision-made fixtures have proved invaluable in simplifying the employee's job.

Because of the nature of the tough, temperamental stainless steels, with which Ryan works, forming techniques have been an important factor from the beginning. Ryan pioneered in the adaptation of the drop hammer to this work, installing the first group of Ryan-design hammers in the late thirties. These tools have become the key forming instrument of the industry because of their flexibility in meeting the versatile requirements of exhaust system production with economy.

Since World War II, Ryan production of parts through the hammer forming department has increased from 3.8 parts per manhour to a record-breaking 9 parts per manhour. The use of "feeder dies," "pre-positioning pins" and water soluble lubricants have aided this production efficiency.

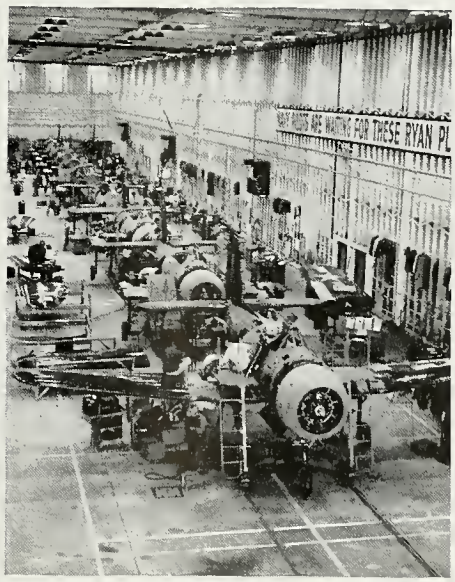
Recently, Ryan installed additional hammer facilities in the form of Cecostamp air hammers. These fast-acting tools have been located on special floating foundations of concrete inertia blocks cushioned upon coiled steel springs. In this way, the surrounding employees and equipment are isolated from the tremendous impact of the 7,000 pound hammer.

The other major forming division at Ryan is the "press room" which contains 25 modern hydro presses, stretch presses, punch presses and similar metal crushing giants. Recently, four towering, eccentric-gear presses have been installed in this area to blank out large stainless steel components for jet engines. Highlighting a trend away from small parts to large single-piece structures, these mammoth presses can exert up to 600 tons of pressure at each press stroke.

Throughout the plant, Ryan has heavy concentrations of modern machine tools to accomplish the high precision which is a requirement of the sheet metal and machined member components which Ryan builds. Constantly adding to these facilities, Ryan now has one of the industries most complete arrays of vertical turret lathes, radial drills, milling machines, boring machines, routers and other precision metal-working tools.

GIANT LENS — King-sized camera is focused by operators Dyche Clark (left) and Garland Rountree.

PT-21s — Sleek fuselages far Ryan PT-21 Army trainers were mass produced for 1941 assembly lines.



FR-1s — World's first prop-jet was Ryan FR-1 "Fireball" which pioneered jets for carrier operations.

NAVIONS — Popular post-war private plane is Ryan's Navion used by business, Army and agriculture.

"I HAD NO IDEA THE RYAN PLANT WAS SO BIG!"

That's the comment most often made by the first-time military or industrial visitor to the San Diego factory of the Ryan Aeronautical Company.

Somehow, possibly because Ryan made its first mark in the military aircraft field by manufacturing two-place trainer planes, many people have erroneously thought of its production facilities as being in the same class as the modest factories of some "light-plane" builders.

While continuing to be identified as a prime airframe manufacturer, Ryan has branched out in recent years from building Navy fighters, Navion personal planes and target drones to become a major supplier of high-temperature sheet metal components for piston, jet and rocket engines; and as a manufacturer of larger airframe assemblies.

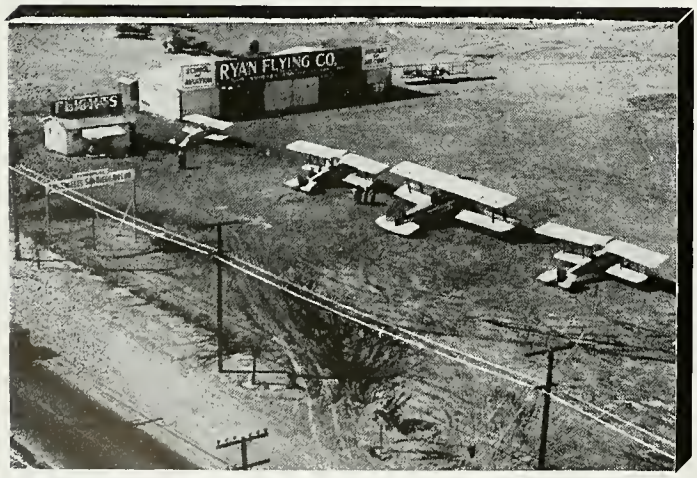
This diversification has demanded more and more specialized production equipment and manufacturing facilities, so that today Ryan has in excess of three-quarters-of-a-million square feet of factory production area on its 40-acre leasehold adjacent to Lindbergh Field, San Diego's municipal airport.

While Ryan's modern factory looms large in size and production volume today, the beginnings were modest indeed. In similar vein, Ryan has grown steadily through the years as a business organization, starting as a one-man venture in 1922. Today its net assets of more than $5½ million are owned by over a thousand shareholders and it employs four thousand workers.

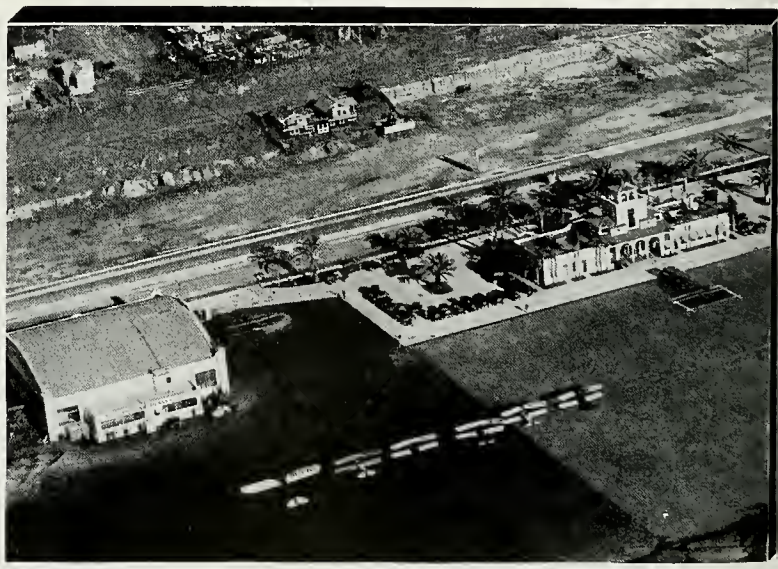
During its early years the Ryan organization was operated as a sole-ownership enterprise by T. Claude Ryan, its founder and president. Later it became

WE'VE NEVER STOPPED GR

From modest beginnings, Ryan's plant has grown to huge proportions



1925 — Ryan's first assets were a rebuilt Jenny and a piano crate for an office. A few years later, Ryan Flying Co. consisted of one hangar and several planes (remodeled Standards and Cloudster), pictured at Dutch Flats air field.



1932 — After Lindbergh Field was built by reclaiming land from San Diego bay bottom, Ryan built handsome administration building and hangar adjoining Pacific Highway. Here were housed activities of the factory and of the Ryan School of Aeronautics.

a partnership; but it was not until June 1931 that the business was formally incorporated in California as the Ryan School of Aeronautics, Ltd.

At that time the Board of Directors consisted of T. Claude Ryan, Earl D. Prudden, the school's sales manager, and Miss Adelaide Smith, who also served as corporate secretary.

In 1934 a few individual investors joined Ryan and Prudden, as principal stockholders, in order to enlarge the scope of operations. The present corporate name, "The Ryan Aeronautical Co.," was adopted in May, 1934.

With the expansion of its airplane manufacturing activities in the mid-thirties, when the S-T trainer was introduced, the need for public financing became apparent and Ryan sought out the investment firm of G. Brashears & Company of Los Angeles, which was then underwriting the first stock issues of Lockheed Aircraft Corp. and other new aviation enterprises.

George C. Woodard, Treasurer and Director of Brashears, and prior to that in the banking and public accounting fields, took the new Ryan financing project under his direction. Out of that business relationship grew a new and lasting association with the Ryan organization. In 1942, Woodard became a Director of the Ryan Aeronautical Company, and moved to San Diego to take up new duties as its Executive Vice President.

The first public stock offering was made in 1936, and other increases in capital were obtained during the next four years. These several issues of common stock resulted in the present capital structure of 439,193 shares of $1.00 par value, and a paid-in surplus of $513,439 for a total paid-in capital of

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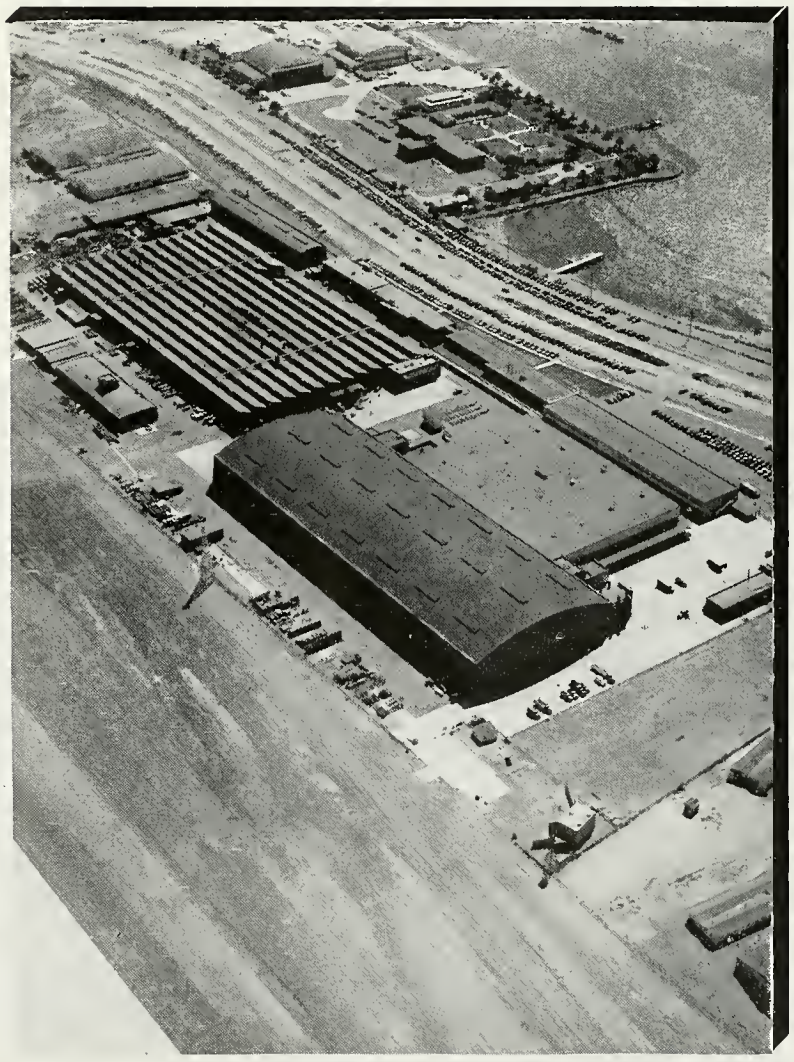
DWING!

1940 — Expansion made it necessary to move to "wide open spaces" at opposite side of Lindbergh Field, near Harbor Drive. Sawtooth-roofed structure was the first unit of plant that kept growing to accommodate production needs.



1951 — Original factory building, upper left portion of picture, has been greatly expanded. Among additional structures is huge final assembly building, with domed roof. This photo was taken before construction of large jet engine building in the space at lower right.

$952,632. Since then, $4½ million have been "plowed back" and retained for use in expanding the business to its present stature. Cash dividends paid to the owners since the company was started are in excess of a million and a quarter dollars.

Shares of the company were admitted to trading on the Los Angeles and San Francisco Stock Exchanges in 1937, and on the New York Curb Exchange in 1940.

Today, in addition to Ryan, Woodard and Prudden, the Board of Directors includes C. Arnholt Smith, Vice President and Chairman of the Board of the United States National Bank of San Diego; and Melvin H. Lockett, partner, Mattison, Thomas & Lockett, certified public accountants of Los Angeles.

The company's financial reports for the first few years showed the modest scale of operation, but reflected sound business principles and the ability to operate in the black.

The $112,000 gross revenue and $9000 net profit of 1935 had grown to sales of $845,000 and net income of $90,000 by 1939, the last "pre-war" year for the aircraft industry.

At the peak of war production, Ryan business was at a $55 million annual rate, declining to $8 million annually prior to the Korean War. The company's only unprofitable year was 1947 when a loss resulted from discontinuance of a non-aeronautical "post-war" product.

Backlogs of orders on hand, too, had a habit of spiraling right off the graphs in the firm's executive offices. From a modest $300,000 at the start of 1939, unfilled orders rose to $1½ million within a year; then to $15 million by Pearl Harbor and $100 million three years later. At this writing they stand in excess of $70 million.

Just as the company expanded in business volume, so did it show a steady, healthy growth in its physical plant. With the first defense orders showing up on the horizon in mid-1939, Ryan began construction of a new $150,000 aircraft factory, offices and engineering buildings at its new, present location adjacent to San Diego Bay and Lindbergh Field.

In a matter of months after occupying the new factory, Ryan was building an addition which doubled floor space; and by 1945 the company had plunged into its fifth major expansion in as many years. Most imposing of all was the final assembly building for the production of Ryan Fireball jet-pushed, propeller-pulled Navy fighters. This huge concrete-walled structure had a clear span roof whose unsupported built-up wood trusses were 200 feet long. At that time the 200-by-570 foot building was the largest wood-truss structure in the world without supporting posts to mar its unobstructed work areas.

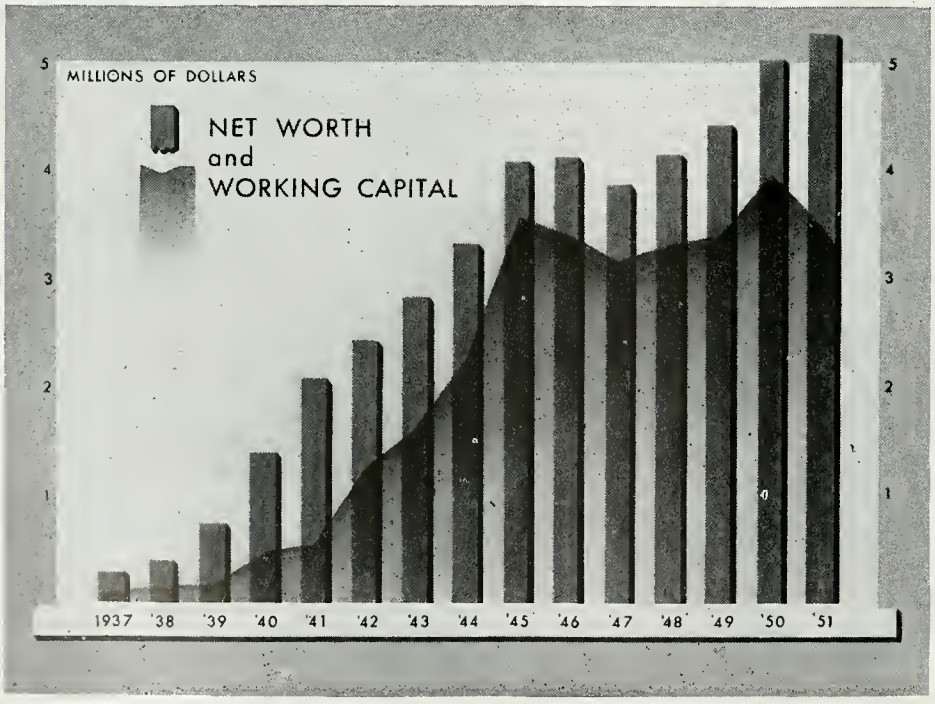
But the growth in physical plant didn't stop with World War II. With the advent of the jet engine — a "natural" for Ryan's experience in manufacturing sheet metal components — new, more specialized production facilities were needed.

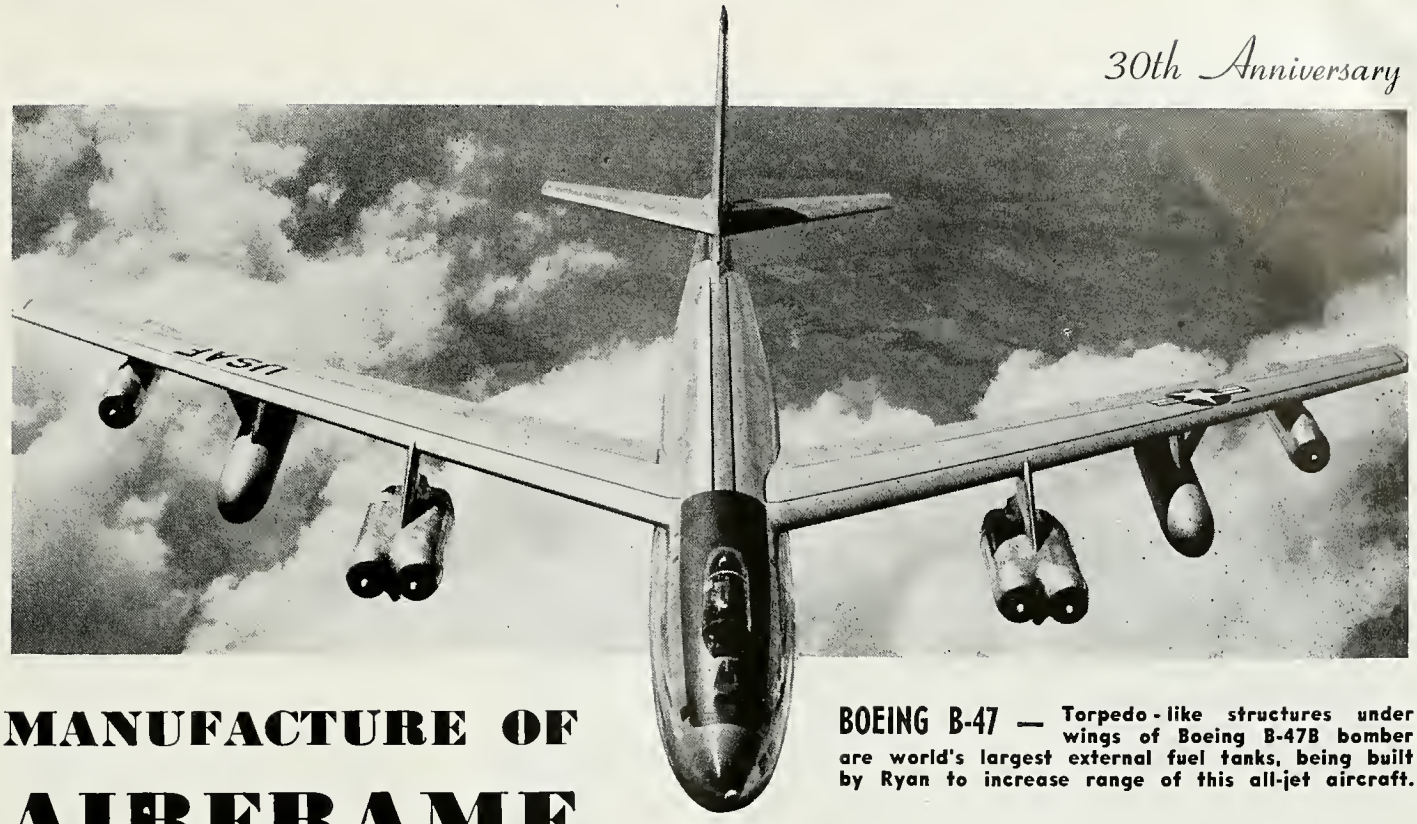
In 1951 construction began on the company-owned jet engine parts building, a 250-by-300 foot structure which was occupied early in 1952 and which is now in full scale production.

RYAN GROWTH IN SUMMARY
1936 to 1951

	1951	1946	1941	1936
GROSS REVENUES	**$22,277,175**	**$11,973,353**	**$8,390,201**	**$117,521**
Operating Expenses	21,449,571	11,473,500	6,322,301	113,299
Income Before Federal Taxes	827,604	499,853	2,067,900	4,222
Federal Taxes	425,000	199,533	1,398,297	893
NET PROFIT	**402,604**	**300,320**	**669,603**	**3,329**
Current Assets	15,609,945	5,776,333	3,413,484	154,147
Current Liabilities	12,285,337	2,242,251	2,835,968	63,735
WORKING CAPITAL	**3,324,608**	**3,534,082**	**577,526**	**90,412**
Misc. Assets and Liabilities	(66,651)	3,826	(7,036)	3,176
PLANT FACILITIES AT COST	**4,054,320**	**2,041,248**	**1,942,651**	**161,845**
Depreciation Charges	2,095,205	1,450,459	418,717	28,334
CURRENT PLANT VALUE	**1,959,115**	**590,789**	**1,523,934**	**133,511**
NET WORTH OF THE COMPANY	**$5,217,072**	**$4,128,697**	**$2,094,424**	**$227,099**

1952 RESULTS — Charts above and below include financial results to end of the 1951 fiscal year. Since then, interim report now available shows net profit of $609,669 for first nine months of 1952. Net worth July 31, 1952 was at an all-time high of $5,694,982, and working capital at peak of $4,037,123.





BOEING B-47 — Torpedo-like structures under wings of Boeing B-47B bomber are world's largest external fuel tanks, being built by Ryan to increase range of this all-jet aircraft.

MANUFACTURE OF AIRFRAME COMPONENTS

RYAN versatility is best exemplified by the variety of aircraft components which the company has built for other manufacturers. Many of these orders involve exacting structures which must be fabricated to precise specifications to mate with components made or assembled in plants thousands of miles away. In other instances, the purchaser outlines the basic requirements for the particular component and requests Ryan to design it as well as build it. This entails a complete engineering service from initial design to final testing.

Best illustration of the latter class of component is the huge Ryan fuel tank. About two years ago, Boeing Airplane Company requested Ryan to assist in design of a new external wing fuel tank which could carry unprecedented gallonage to extend the range of the B-47B Stratojet bomber. With their request they supplied basic information concerning desired capacity, the contours of the tank and design details of the struts for connecting the big containers to the underside of the Stratojet's wings. With this beginning, Ryan engineers went to work.

They created a huge torpedo-like structure which is the largest external fuel cell built. Cylindrically-shaped, with tapered nose and tail domes, the mammoth container is remarkably light in weight because of several Ryan innovations. First, it was designed to take full advantage of the benefits of electric spot welding—a long-time Ryan specialty. It is put together with 30,000 spot welds which are weightless and which present no protuberances to air flow because they are within the aluminum alloy sheets themselves. Special spot welding machines, the largest of their type, had to be designed and built to handle the record-breaking dimensions of these new tanks.

Second, substantial weight was saved by the elimination of all longitudinal members, usually found in large fuel tanks, and the use of few bulkheads. These innovations were made possible by the exceptional strength of the design and the integrity of the spot welding procedure.

The tanks are proving successful not only in the application for which they were originally designed but also in another pioneering project. Permanently affixed to the wings of the Fairchild C-119H, newest member of the "flying boxcar" family, these tanks are used to carry the entire fuel supply, externally. By moving the fuel out of the C-119H's wings, twenty-two internal fuel cells have been eliminated, with a saving in weight of 600 pounds. Also, fire hazard and maintenance requirements are materially reduced.

Undoubtedly the largest components which Ryan has built, both in size and value, are fuselage sections for Boeing C-97 Stratofreighters. Comprising the aft section of the Stratofreighter's fuselage, these big aluminum alloy structures

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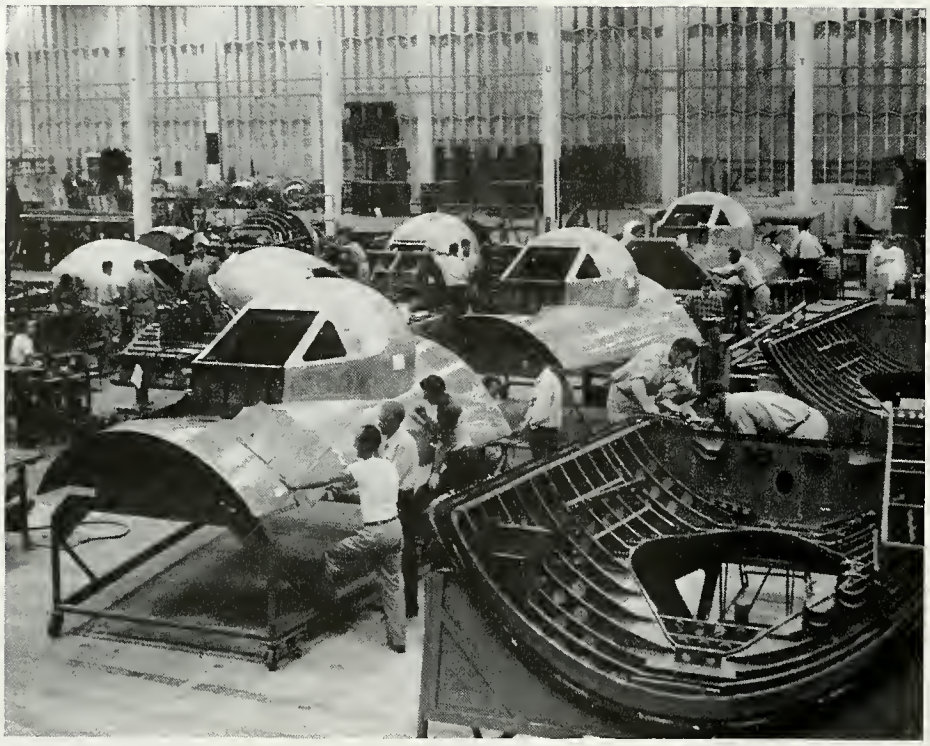


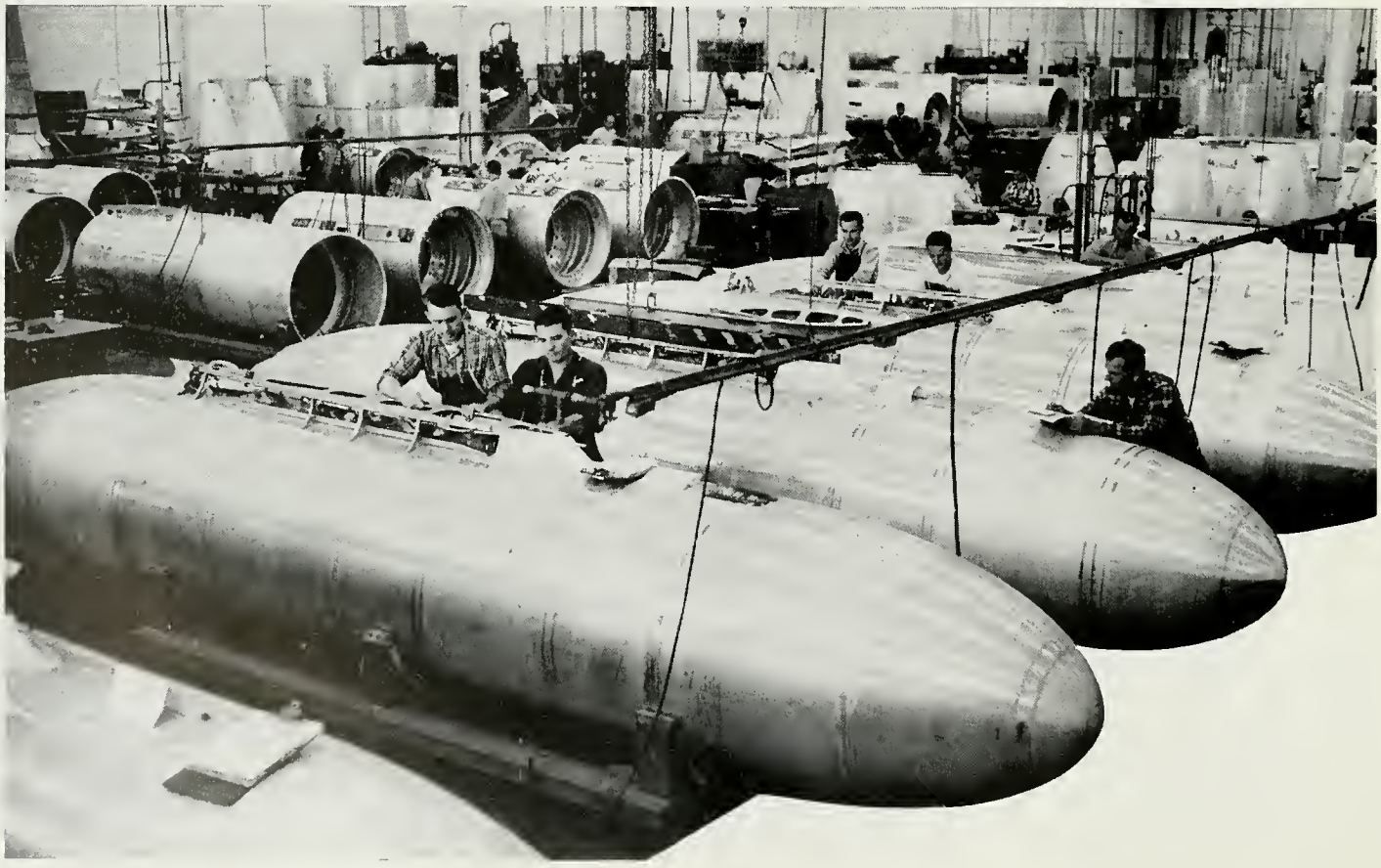
REFUELING PODS — **Use of Boeing Stratofreighters as aerial tankers for midair refueling was made possible by construction at Ryan of pod in fuselage for operator and refueling boom. Pods replace cargo doors, also Ryan-built.**

are pressurized and flush-riveted. The C-97's are equipped with clam-shell type loading doors and retractable ramps. Cargo can be loaded through the bays with self-contained electric hoists. Trucks, light tanks and artillery can be rolled up the ramps under their own power.

In manufacturing large numbers of the sections, Ryan had to develop accurate tooling and maintain extremely close precision so that the aft sections would match perfectly with the Boeing fuselages in Seattle, Washington.

In 1950 the Air Force added a new role to the Stratofreighter's versatile repertoire—that of an aerial tanker for mid-air refueling. With great urgency the plans for this conversion were started at Boeing and began to flow to Ryan through interlocking engineering, production and tooling departments. The project was taken on so fast that detail tools were being made in San Diego before Ryan had 15 percent of the total engineering information from Boeing. This unorthodox overlapping of sequences saved extensive periods of time and, due to extremely close coordination,

LARGEST FUEL TANKS — **Bigger than fuselages of some private planes are these external wing fuel tanks being produced at Ryan for Boeing B-47 bombers. Similar tanks are used for new Fairchild C-119H cargo transport.**



the tools produced were as accurate as those built under normal circumstances.

Working between 65 and 70 hours weekly, Ryan fuselage employees tooled up for the production of a pod unit. Containing the station for the refueling boom and operator, the pod is slipped into the loading bay in place of the cargo doors and attached to the door hinges. From this unit, the refueling boom operator, who is in communication with both planes during the critical fuel transfer period, directs the operation. Converted Stratofreighters have successfully refueled Boeing B-47 Stratojets, B-50 Superfortresses, North American F-86 Sabrejets, Republic F-84 Thunderjets and other prominent aircraft in flight.

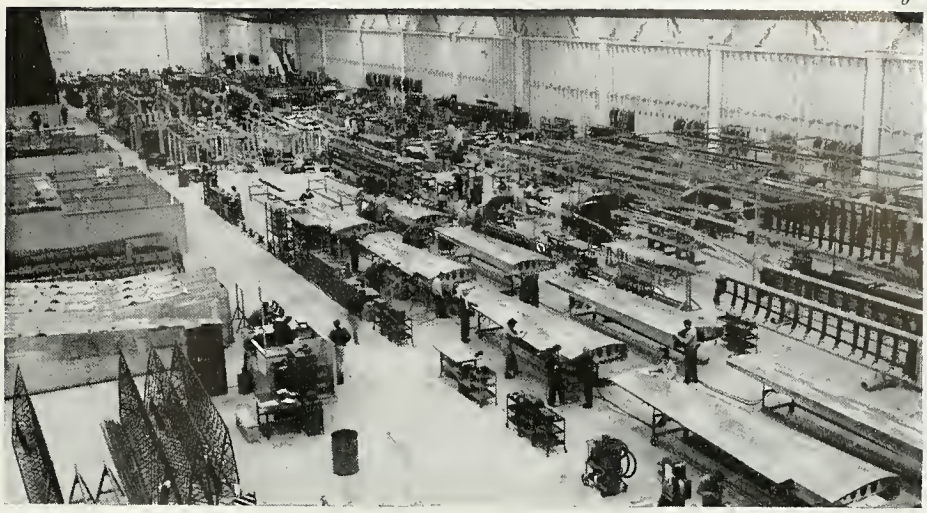
Ryan also builds all of the floor beams used in Boeing Stratofreighters. Patterned after structural steel "I"-beams, these aircraft members are extremely strong yet light in weight. A thousand spot welds are used to form them. Forty-nine Ryan floor beams support the weight of 68,000 pounds of cargo which each Stratofreighter can carry.

Ryan began building aircraft components in 1942 after completing the production of hundreds of the famous PT-22 low-wing trainers — World War II's popular primary training plane. First components were major structures for a new scout observation plane Ryan was to build under contract with the U. S. Navy — the SOR-1, based on a Curtiss-Wright design. Also, in 1942 Ryan produced substantial numbers of stainless steel firewalls for the Lockheed "Hudson" medium bombers which saw service in Australia in anti-submarine patrol work.

In 1943, the Consolidated B-24 heavy bomber was making its presence felt in the skies over Europe and Ryan was building several major components for the B-24 assembly lines. The large outer wing panels, elevators, rudders and ailerons were flowing from Ryan in impressive volume in this period of production for war.

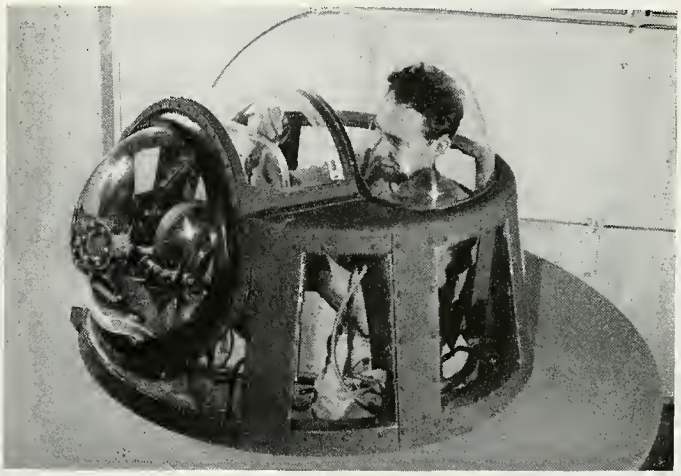
Another specialized product which Ryan turned out to meet the needs of wartime was the .50-caliber, twin-gun turret. Required to arm Consolidated PBY-5 "Catalina" flying boats, these plastic-domed gun turrets contained all of the equipment for the comfort and efficiency of air-borne machine-gunners.

Since these early beginnings, Ryan has continued to build aircraft components for other manufacturers in addition to the other phases of fabrication pursued. Today, this division accounts for an important share of the total production of the company.

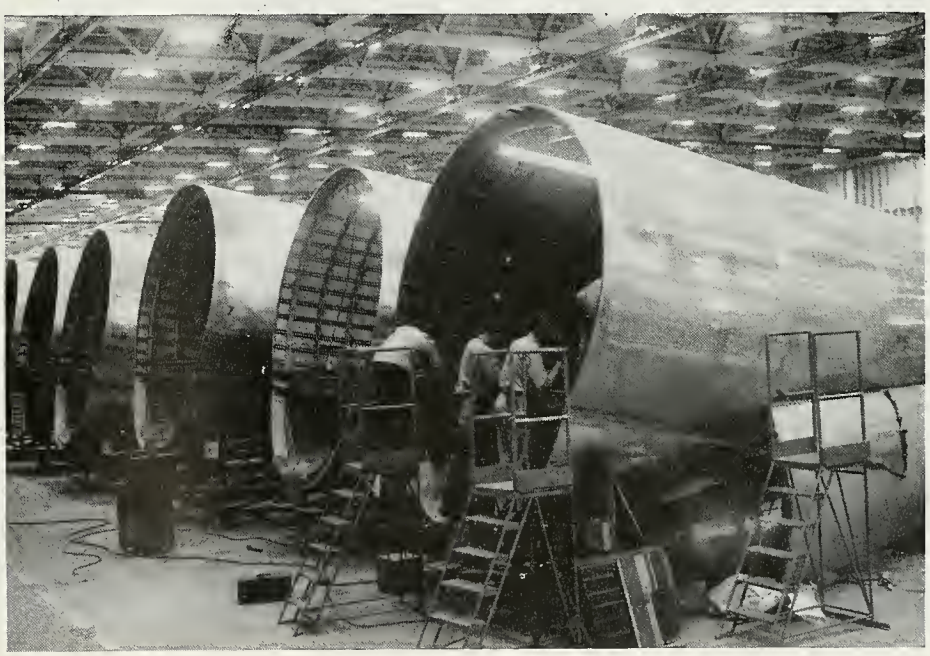


WINGS — **Outer wing panels for one of World War II's mightiest planes, the Consolidated Vultee Aircraft Corp. B-24, were built in large quantities by Ryan, which also produced elevators, rudders and ailerons for this 4-engined bomber.**

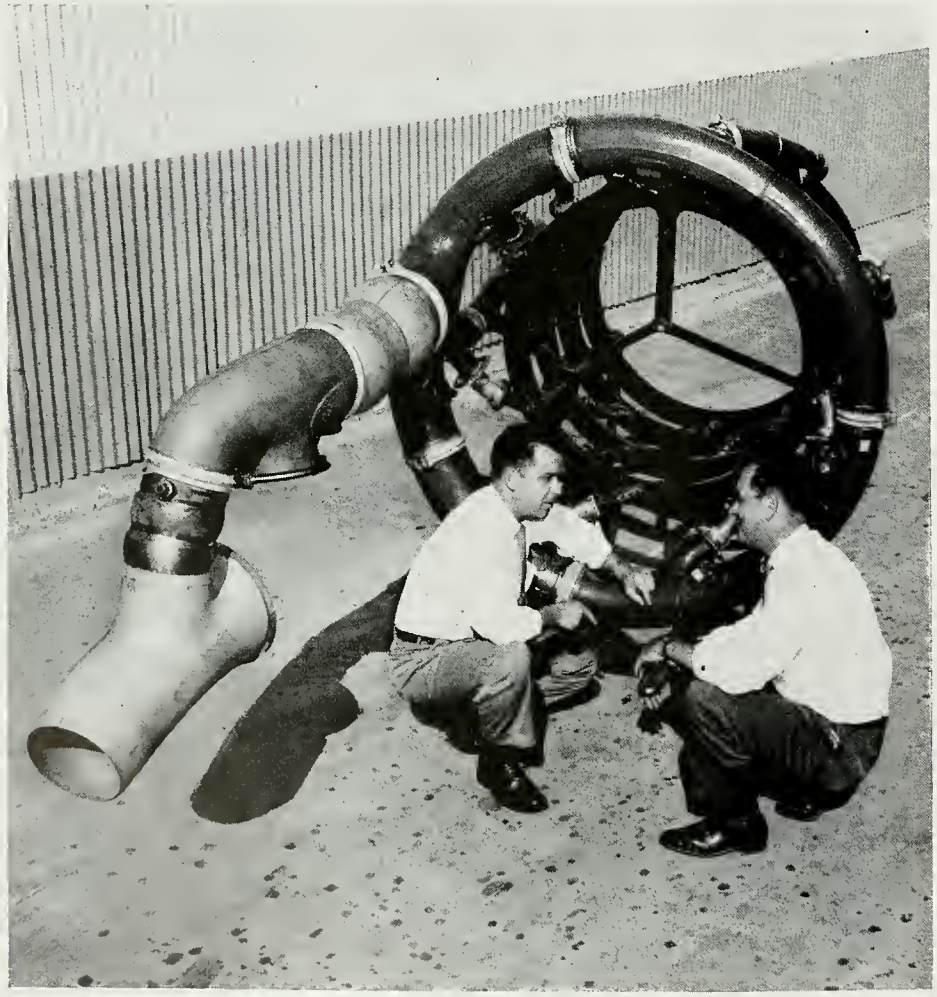
GUN TURRETS — **One of major aircraft components produced by Ryan during World War II was plastic-domed turrets for two .50-caliber guns used to provide protection for Consolidated Vultee's versatile PBY-5 Catalina flying boats.**



C-97 FUSELAGES — **These fuselage sections for Stratofreighters are largest aircraft components Ryan has built. Fabricated of aluminum alloy, they comprise aft section of fuselage, and are pressurized and flush-riveted.**



Answer to RED HOT PROBLEMS



EXHAUST SYSTEMS — Ryan service manager C. L. Foushee (left) and T. C. Hacker, manifold engineer, examine the smooth ceramic coating on this Ryan-built exhaust system for an engine of the Boeing B-50 Superfortress bomber.

THIS has been called the "high temperature age". Aviation has gone "jet" and there is no doubt this engine has put the heat on the search for new materials which will stand up to volcanic temperatures.

Unlike its cast metal predecessor, the piston engine, the jet power plant uses a large proportion of sheet metal and machined components which must withstand withering heat and vibration. With long experience in building exhaust systems for piston engines, Ryan was well qualified to assume a leading position in this new field.

Another factor contributed to this success. Ryan enjoys the distinction of being the only manufacturer, building jet engine sheet metal components, who has designed, built and flown jet planes. Firsthand familiarity with flight research has been an invaluable aid to all engineering personnel in developing better components for jet and piston engines, afterburners, ramjets and rockets.

CERAMIC COATINGS

Latest accomplishment in the quest for high temperature materials is Ryan's pioneering in proving the advantages of thin ceramic coatings. During World War II, Ryan performed original work in this area by successfully ceramic coating hundreds of mild steel exhaust systems for Douglas A-20 attack bombers, North American B-25 bombers, AT-6 trainers and others.

Three years ago, foreseeing the scarcity of strategic materials, the Ryan de-

velopment laboratories began a series of unique flight tests of Ryan ceramic coated exhaust sections. Under the joint sponsorship of Boeing Airplane Company and Ryan it was arranged to install the Ryan ceramic coated exhaust sections on the engines of Boeing Stratocruisers in the service of four global airlines.

After 2000 hours of testing and laboratory examinations, Ryan published a technical report establishing the benefits which specific ceramic coatings provide in extending service life of aircraft exhaust systems. The direct results of this work have been a flow of orders which has pushed Ryan into top place as the volume producer of ceramic coated components for the aircraft industry.

The entire Stratocruiser fleets of all airlines using these Boeing transports are being equipped with Ryan ceramic coated exhaust systems. The fleets of Convair 240 and 340 airliners, in service and going into use, will fly with ceramic coated exhaust components built by Ryan. Experimentally, Ryan is providing these coatings on exhaust systems for the engines of Douglas DC-6 aircraft, Pratt and Whitney Wasp Major engines and combustion chambers and transition liners for General Electric J-47 jet engines.

EXHAUST SYSTEMS

Ryan entered the field of high temperature metallurgy 15 years ago in response to the need for better built exhaust systems for aircraft power plants. Thirty years ago, when T. Claude Ryan launched his tiny organization, an aircraft exhaust system was a simple affair. It usually consisted of pieces of bent pipe which channeled the hot gases just high enough to singe the pilot's hair if he stood up in the open cockpit. If he avoided being ignited or temporarily blinded by the flames, he still ran the risk of asphyxiation when air currents blew the gases his way.

As aircraft engines began their steady climb upward in horsepower, greater volumes of compressed air were packed into their throbbing cylinders. This stepped up the flow of searing exhaust gases and necessitated the application

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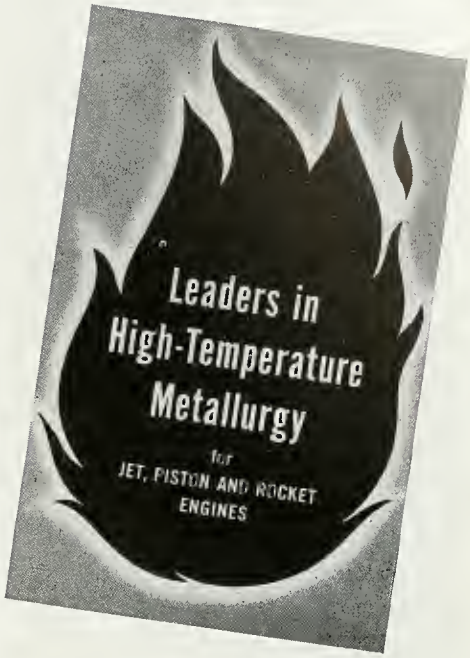
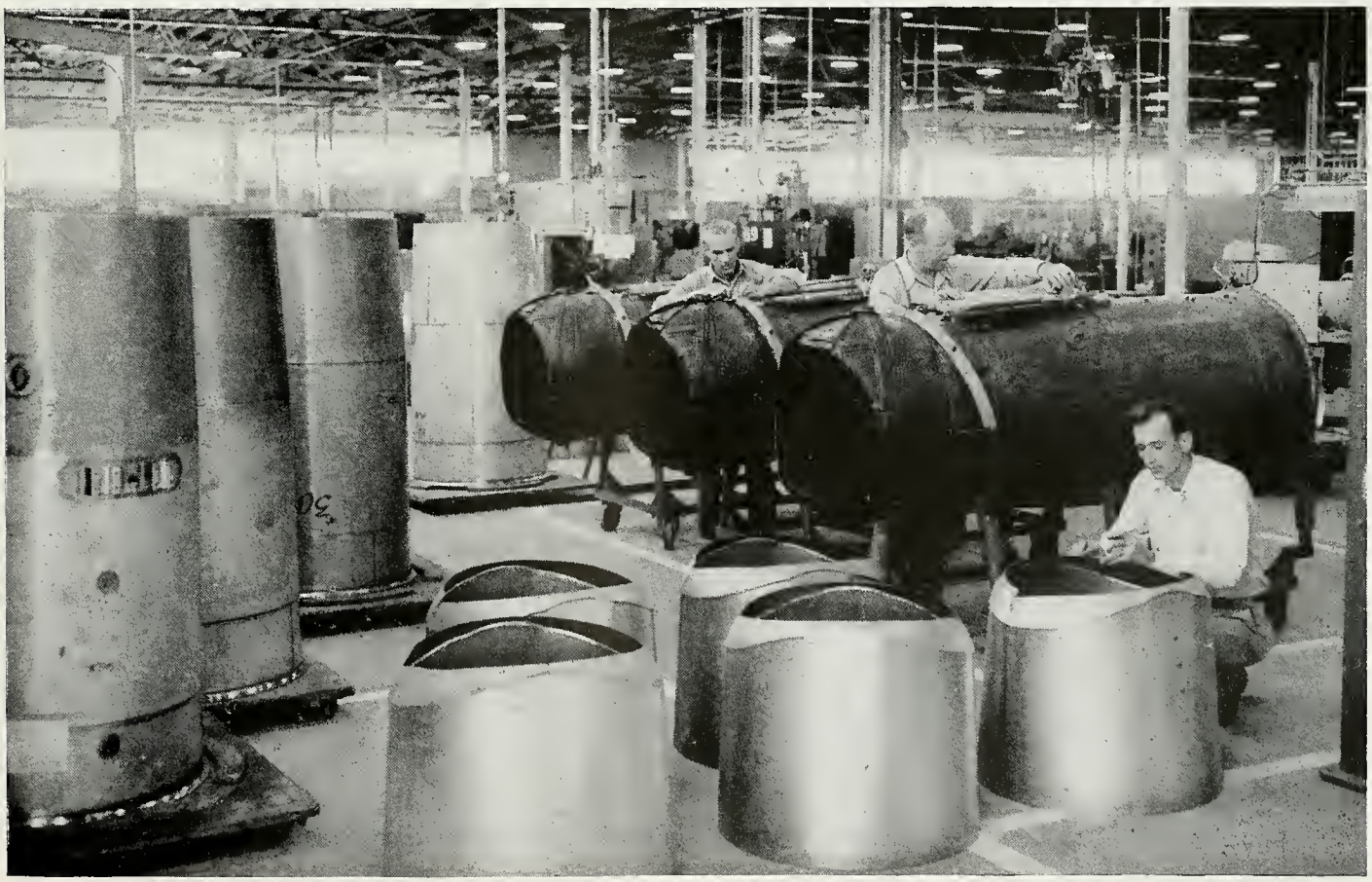
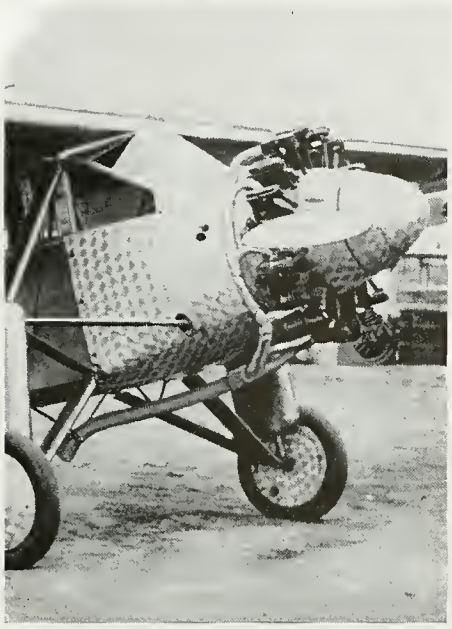


JET PARTS — Containing the hottest operating parts in modern power plants, Ryan-built after-burners greatly increase thrust but consume more fuel than jet engines. Gas temperatures, measured in the sizzling jet stream, have soared to 3000° F.





1927 — Early version of Ryan collector type exhaust system was built for famous Ryan Brougham of 1927. Power plant was a nine-cylinder Wright radial.

CERAMICS — At California Metal Enameling plant, Ryan-made components for jet, piston and rocket engines are ceramic coated. Extremely thin film of ceramic coating protects surfaces of these parts against the ravages of oxidation and corrosion. Technique extends service life and conserves critical alloy supply.

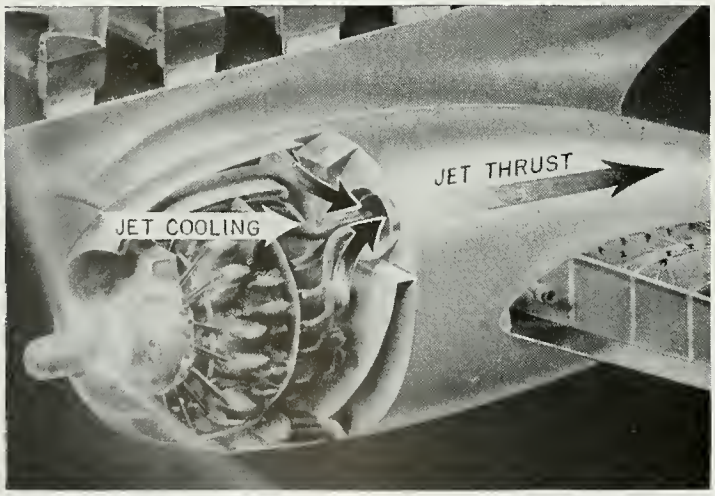
of engineering talent to dispose of this destructive element.

As early as 1927, the Ryan organization built its own exhaust systems for the engines of Ryan planes. The famous Ryan Brougham of that year was equipped with a Ryan collector-type manifold which was far advanced for that period. Made of flexible and rigid steel sections, it was mounted on a Wright J-5 radial engine.

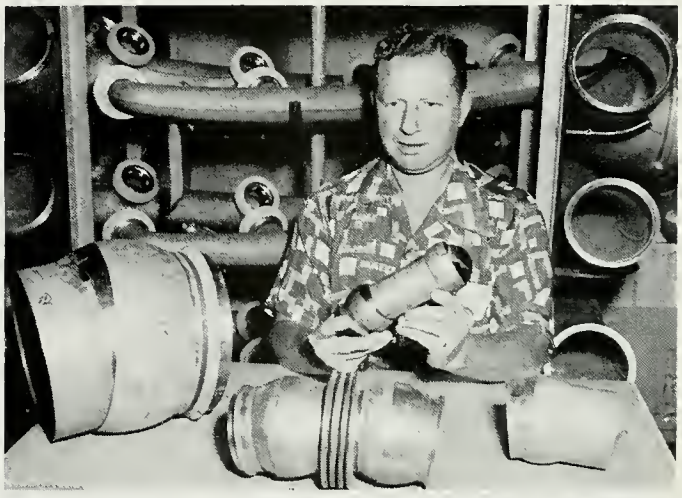
Under the direction of T. Claude Ryan and Sam C. Breder, director of the customer service division, Ryan introduced a fresh approach to the industry when it was decided to build exhaust equipment commercially. Airframe manufacturers were encouraged to consult with Ryan exhaust systems engineers before the plans for new aircraft were crystallized. The exhaust equipment was then considered in terms of the airplane's needs and not as an afterthought. A world-wide field service was established with skilled Ryan technicians following through on the performance of the manifolds in service.

JET THRUST EXHAUSTS

Dove-tailing the efforts of design engineers and metallurgists, Ryan has produced a series of important achievements which have paced the industry's progress. The ejector-type exhaust stack is a Ryan innovation. Introduced in the exhaust equipment for the Douglas A-20 attack bomber, this design produces increased aircraft speed through the utilization of jet thrust generated by the escaping exhaust gases. After the war, Ryan built the first ejector-type exhausts for commercial service when the Douglas DC-6 exhaust equipment was conceived. In the new Convair 340 airliner, this principle is again harnessed



JET THRUST — Ryan exhaust system for Convair 240 pays dual dividends in jet augmented thrust and cooling. Pioneered by Ryan, these are also Convair 340 features.



BALL & SOCKET — Ball-and-socket joints are displayed by Wilfred Mead. An exclusive Ryan-patented device, they are used in aircraft, trucks and troop carriers.

in the Ryan exhaust components. Developing an additional 375 pounds of thrust, or 255 horsepower at cruising speed, the design treats each exhaust tube as a miniature jet engine.

AUGMENTED COOLING

Another Ryan innovation is the use of exhaust energy to obtain augmented engine cooling. This was pioneered in the Ryan FR-1 Fireball Navy fighter. By ejecting the exhaust gases within the engine nacelle, an aspirator effect was produced in which the gases created a partial vacuum within the enclosure which sucked added cooling air by the engine. This technique was introduced to commercial use in the Convair 240 airliner and later incorporated in the 340 version. It is so effective that adequate engine cooling for the 340's power plants is obtained even at idling speeds on the ground and the nacelles can be more completely encased for maximum aerodynamic streamlining.

BALL-AND-SOCKET

The ball-and-socket joint, used in the exhaust systems of a variety of military and commercial planes, is an exclusive Ryan-patented device. Flexible, yet resistant to gas leakage, this universal-type joint permits the free movement of the power plant under power surges without affecting the integrity of the exhaust system. The joints accommodate thermal expansion movement and allow the designer to support the weight of the exhaust equipment on the engine mounting or nacelle rather than on the engine itself. Ryan ball-and-socket joints are used in Army personnel carriers and Boeing's experimental gas turbine-driven truck, in addition to their application to aviation.

AFTERBURNER — Yawning mouth of the adjustable nozzle is seamwelded to a Ryan afterburner in huge welding machine which has 5-foot "throat." Robert Ogier carefully controls the assembly process to insure a smooth, tight joint. In operation afterburners get hotter than most furnaces.

EXHAUST HEAT ENERGY

Impressed with the enormous quantities of heat energy, amounting to millions of BTUs per hour, which are ejected by an aviation engine, Ryan engineers have devised several methods for putting this energy to work. Each application adds speed to the airplane because of the elimination of the weight of heaters and fuel otherwise required.

The turbosupercharger is an example of this utilization. Ryan designed the first turbosupercharger exhaust system for commercial application in the exhaust equipment for the Boeing Stratocruiser. In this structure, the fast-flowing exhaust gases are used to drive a bucket-wheel turbine at 30,000 rpm. The turbine turns an air compressor which packs huge volumes of compressed air down the engine's "windpipe". By thus increasing the air pressure in the cylinders, the turbosupercharger is capable of doubling the horsepower and reducing the fuel consumption of the engine at high altitudes. Permitted to fly at higher altitudes, the Stratocruiser can then realize greater speed, range and payload.

Other useful applications to which exhaust heat energy has been devoted by Ryan engineering, are the heating of cabins, carburetors, gun turrets and the anti-icing of wings and tail surfaces. In these instances, the hot exhaust gases are ducted through heat exchangers where they warm a flow of air which is conducted to the area to be heated. Typical example is the heating of the cabins in the Navy's K-type Goodyear blimps. The engine's exhaust heat provides crew comfort through Ryan exhaust systems which require no added fuel.

FUEL TANK PURGING

Surprisingly, exhaust gases may become most useful, not because of their physical energy, but due to their lack of chemical energy. Previously drained of all combustible elements by the raging flames in the cylinders, these inert gases can be transformed into efficient fire-suppressing fluids. Ryan has done advanced work in developing a method of displacing dangerous oxygen-laden fumes in fuel tanks, wing cavities and surrounding areas with specially treated exhaust gases of low oxygen content. Labeled "fuel tank purging," this little-known expedient may eliminate fire and explosion hazards from future flight.

(Continued on next page)

Recently, Ryan was awarded an Air Force contract for the development of an exhaust gas converter. Called a "de-corroder," Model 57, this unit is designed to remove the chemical contaminants from exhaust gases. By rendering these gases safe for contact with aircraft structural metals, the heat energy they contain can be harnessed to perform many heating tasks in both jet and piston engined planes, such as wing anti-icing, cabin heating and others.

NEW METALS

Because both design and materials play vital roles in the performance of high temperature exhaust equipment, Ryan design engineers and metallurgists work in close consort. All of the applicable types of stainless steel have been subjected to intense investigation by the development laboratories to determine the most desirable formulae and finishes for aircraft applications.

Ryan metallurgists ascertained the superiority of stainless steel, with a chromium-nickel ratio of 18-10 percent, over the conventional 18-8 types for certain products and ordered the first batches of this type from the steel mills for the industry. In exhaustive tests, Ryan laboratory experts determined the effectiveness of stabilizing heat treatment for stainless steel and the effects of carbon absorption under conditions of service. Such phenomenon as volatilization of stabilizing elements under welding heat and movement of various finishes between forming dies was given close examination to glean the best characteristics from the metal which the mills could instill.

Seven years ago, Ryan became interested in the possibilities of a newer stainless steel formula — 19-9DL, and

Metallurgists Ruth Adams and Wilson G. Hubbell make a spectrographic analysis of a jet part to check its composition.

requested samples from the mill for laboratory studies. As a result, Ryan has introduced this metal, in sheet stock form, to the aircraft industry and now consumes practically all of the present production for exhaust systems fabrication.

TITANIUM

In similar fashion, Ryan metallurgists have studied the newer metals of titanium and Rosslyn metal both from a laboratory and production viewpoint. Titanium exhaust shrouds have been built, under laboratory supervision, for Piasecki helicopter engines and are proving eminently successful in this new use. From Rosslyn metal, Ryan has made combustion chambers and transition liners for jet engines, afterburner rakes and exhaust systems. These components are undergoing tests to prove the possibilities of this interesting sandwich-type material.

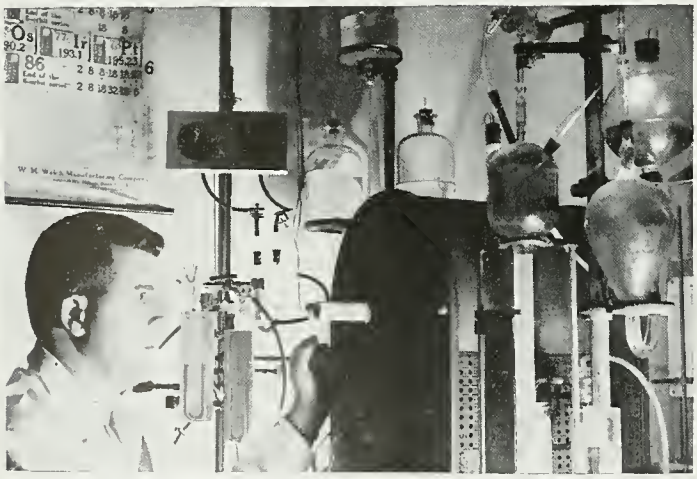
On one occasion, Ryan metallurgists have conceived a new alloy, tailored to meet a specific need. Searching for a better cast metal to stand up to 1800°F. temperatures without galling, Ryan synthesized "Rynalloy" with prescribed characteristics. Capable of withstanding temperatures 300°F. greater than other available alloys, Rynalloy is being successfully used in thousands of Ryan ball-and-socket joints.

AFTERBURNERS

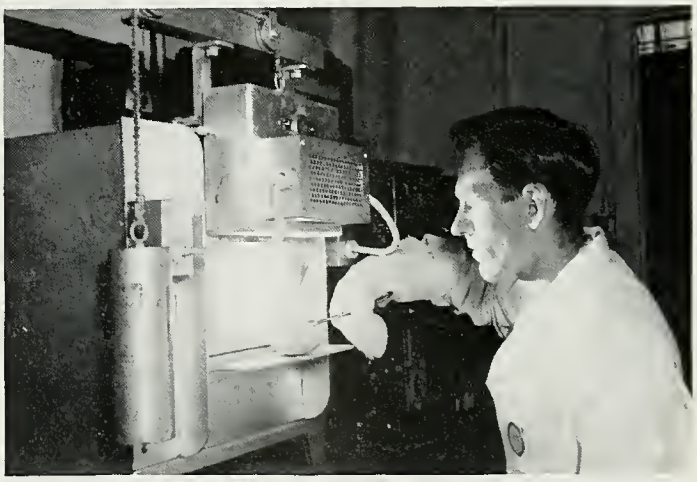
One of the most spectacular products in which metallurgy and design merge in a hurricane of heat is the afterburner. Ryan was the first commercial company to develop this important device—conducting the research in connection with the Ryan XF2R-2 Fireball for the U.S. Navy in 1945. Today, Ryan is turning out quantities of modern afterburners which are descendents of these early models.

ROCKETS

Undoubtedly, the hottest combustion temperatures which sheet metal components must endure are found in the rocket engines which Ryan builds. Used as motors for missiles, these engines uncage thousands of horsepower from tiny combustion chambers in furious bursts of energy. Although the mission of a rocket engine is accomplished in a matter of seconds, this brief life span is almost cut short by the blast of heat from the incandescent combustion chamber. In developing successful designs for high altitude rockets and air-to-air missiles, Ryan has won recognition in the newer rocket engine field comparable to its leading position in the production of high temperature components for jet and piston engines.



A sample of stainless steel is analyzed for carbon content by Alfred Coha, Ryan chemist. Metal is vaporized and volume of CO_2 gas generated is noted to indicate carbon in sample.



Ceramic research is pursued by Dave Adams, Ryan metallurgist as he removes a crucible from a 2300-degree electric furnace which is used to test ceramic material and heat treat metal.

L-17 — Taking off from flight deck of an aircraft carrier somewhere off Korea, unarmed Ryan L-17 heads for battlefield rendezvous with an Army general. This is one of numerous duties to which this liaison plane has been put in war zone.

SOMEWHERE off Korea, a Ryan L-17 Navion is poised on the flight deck of the carrier Badoeng Strait, headed for a battlefield rendezvous with an Army general. . . .

North of Taejon, a pilot on dusk patrol in his unarmed L-17 spots a tank-led enemy column bearing down on an unsuspecting U. N. force. . . . He radios the Air Force, then guides his bristling F-51 comrades down to treetop level, pin-pointing the hard-to-see tanks with landing lights. The Air Force disposes of the enemy, while the Field Forces' Navion skips away to do more "bird-dogging."

When the Army Field Forces and the National Guard acquired some 250 L-17s after World War II, the demand was for a rugged, four-place liaison plane to be used for reconnaissance, personnel and cargo carrying, light transport operations, courier service, general communications assignments and utility work.

But when the Korean war broke out, the field commanders began to find the Navions essential to strictly combat operations, aside from their primary function as "flying staff cars."

An official U. S. Army correspondent with the Eighth Army in Korea, wrote that "the general concensus of Army airmen in Korea is that were it not for the

RYAN PLANES at WAR

KOREA — For low-level observation, Ryan L-17 is unexcelled. Plane is shown over village in Korea.

BRASS — Among top military figures carried by L-17 have been Generals MacArthur, center, and Ridgway.

L-17 Navion in the first six months of the war, the effectiveness of supporting Air Force and artillery fire power would have been far less than was eminently necessary and happily possible."

Lt. Col. R. T. Neumann of Bradenton, Florida, who was Eighth Army aviation officer, remarked:

"Originally designed strictly as a passenger craft, we've used the Navion for long-range missions which took it deep into enemy-held territory, and we used it to direct the great proportion of fighter strikes in the early months. We have been pleasantly surprised at the way it has stood up under incredible conditions."

The L-17 pilots didn't always have to risk their necks by taking the fighters

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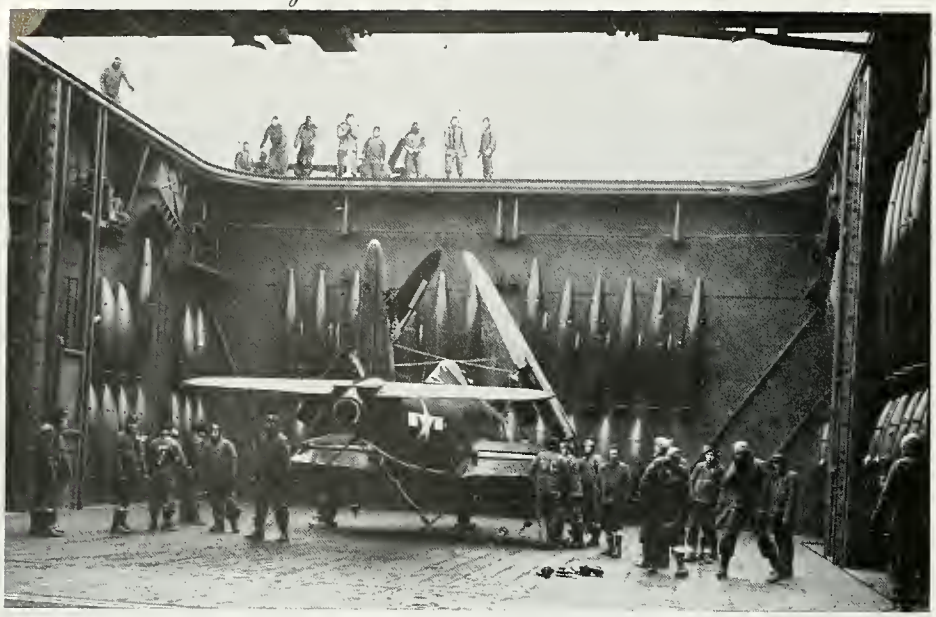

CARRIER — **Rigid tests were given Ryan's FR-1 Fireball by the Navy. Here it is shown moving onto the U.S.S. Midway forward elevator during giant carrier's experimental cruise in sub-arctic regions off Greenland. Fireball was exposed to zero temperatures, then warmed up to test its reactions in frigid weather.**

FR-1 — **Ryan Fireball was designed to intercept the Kamikazes raining destruction on U. S. Navy ships.**

right down to the target when visibility was poor due to weather or uncertain light. Equipped with Very High Frequency radios in contact with both ground troops and other planes, the L-17 observers could give complete descriptions of the objective. Or they would drop smoke grenades on targets.

Eventually, when the Air Force was able to get its "mosquito" squadrons into Korea to direct air strikes, the Navion reverted to its original transport and utility functions, but early in the war these planes, famous to businessmen, ranchers, and sportsmen pilots all over the world filled a vital gap in combat operations.

VF-66 — **This fighter squadron had completed Fireball evaluation and was ready for combat when World War II ended. One of its pilots made first jet carrier landing (picture above, left), when front engine quit.**

The L-17 has carried many noted military commanders, according to Major Michael J. Strok, one of the first of the "Army aviators" (fliers attached to the Field Forces). The one which took off from the carrier Badoeng Strait was flown by Capt. William B. Capps to a highway in the Inchon sector, and soon afterward, Maj. Gen. Edward M. Almond, then commander of the Tenth Corps, comprising the First Marine Division and Seventh Army Infantry Division, was aboard for inspection flights over the combat areas.

Perhaps the most distinguished officers to fly in a Navion over Korea's front lines were Generals Douglas MacArthur and Matthew B. Ridgway shortly before Ridgway relieved MacArthur as Supreme Commander in the Far East.

Navions are still widely used in Korea, to carry personnel and material, and various other assignments. They have also long worked with Army Occupation Forces in Europe, with the Joint Brazilian-U. S. Military Commission in Rio de Janeiro, and with the Greek Air Force.

THE FIREBALLS

The most spectacular planes so far disclosed by Ryan—aircraft that actually ushered in the jet era for the Navy—were destined never to see combat.

These were the FR-1 Fireball Navy fighters, the first planes in the world to combine a conventional reciprocating engine (forward) with jet propulsion (aft).

In 1945, the Kamikazes were raining fiery destruction on U. S. warships operating close to the Japanese home islands. The Fireball was looked upon by the Navy as the salvation, the plane best able to out-perform any enemy fighter.

It was designed to give a well-balanced combination of fighter plane characteristics—exceptional maneuverability and flexibility, because of its jet-plus-propeller powerplant combination; high speed and good combat radius over a wide range of altitudes; high sustained rate of climb at all altitudes; and short take-off and slow landing speed for carrier operation.

Conceived in late 1942, the revolutionary design was engineered and went into production at a pace forced to top speed because of the urgency of the need. Ryan remained one of the few plants on an actual accelerating production schedule

up to the moment the Japanese surrendered. At that moment, the evaluation program of the Fireballs had been completed at the San Diego Naval Air Station and the first squadron under Comdr. John F. Gray was ready for combat assignment.

Earlier, one of the pilots of VF-66 squadron, Ens. Jake C. West, had made the first jet landing abroad an aircraft carrier. Normally the FR-1s "came aboard" using their piston engines during the landing approach. West's was an unpremeditated all-jet landing on the escort carrier Wake Island when his front engine experienced an almost complete power failure. He started his jet engine quickly, continued his approach and landed safely, chalking up another aviation first.

NETHERLANDS INDIES — Greatest quantity of STMs were built for Netherlands East Indies' colonial administration, and by early 1941, they were being delivered by cargo ships at Surabaya, Java. In pressure of emergency, they were used for primary, basic, advanced and blind flying training.

MILITARY TRAINERS

The Fireball was Ryan's first plane designed for actual combat. The company previously had won an international reputation for its military trainers, the famed series of PT's used in the United States for primary instruction and in foreign countries for more advanced training.

In 1937, the Mexican Air Force ordered a quantity of STMs, an adaptation of the Ryan S-T low wing, metal fuselaged, open cockpit planes which had won great popularity among private fliers in many parts of the world.

The Republics of Honduras and Guatemala followed with orders for similar aircraft, and by 1939, Ryan military and civilian trainers were in use in many foreign countries.

Before our entrance into World War II, when it became obvious that our pilot training program would have to be intensified, Ryan won a design competition for a military trainer, and the first of the PTs (the PT-16) — also the first low wing trainer in the Air Corp's history—went into production. This early model and the PT-20s were followed by the best known of the PTs, the PT-22 Recruit, of which more than a thousand were built for basic training of aviation cadets.

The Navy's version, the NR-1, was used as a transitional trainer, between primary and advanced training, at the Jacksonville, Florida, and Memphis, Tennessee, Naval Air Stations.

Wherever used, the Ryan trainers gave exceptional service because of their unexcelled flying characteristics and ability to withstand the rough handling given them by novice pilots.

An enclosed metal cabin plane, the S-C, was also developed by Ryan, and early in World War II a number of these were designated L-10s and used by unpaid volunteer members of the Civil Air Patrol on anti-submarine duty off the southeastern and Gulf coasts. They carried two demolition bombs—just in case.

Although there is no record of a C.A.P. plane destroying a sub, hundreds

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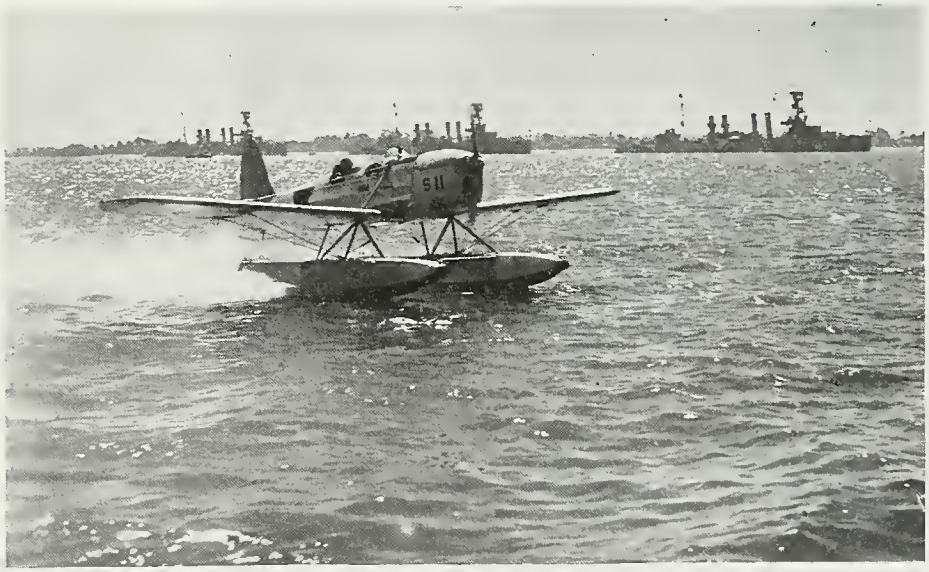
STMs — Used by Guatemalan Air Force, this version S-T gave Ryan foothold in military field in '37.



SEAPLANE — Equipped with pontoons, STM land plane trainers became seaplanes in Netherlands East Indies air service. When the Japanese air raids interrupted training, these planes were flown from Surabaya naval base to nearby rice paddies, which were flooded to provide emergency landing fields for camouflaged craft.

R.A.A.F — When the Japanese invaded Java, they captured many Ryan STM land planes and used them to train their own fliers. But many were saved and were shipped to Australia for use by the Royal Australian Air Force, as shown above.

S-C — The pride of many a private owner was this enclosed metal cabin plane developed by the Ryan company in late 1930s. During early period of World War II, some were designated as L-10s. They were used by unpaid volunteers of the Civil Air Patrol. Note simplified bomb sight and rack shown by arrows on fuselage.

NAVY NR-1 — Navy's version of the famed PT-21, of which more than thousand were built, was the NR-1, pictured above with group of cadets and their instructor. They were used as transitional trainers, between primary and advanced training at the Naval Air Stations in Jacksonville, Fla., and Memphis, Tenn.

of seamen owe their lives to the daring of those pilots, who spotted torpedoed vessels going down and radioed for help from the Coast Guard and the Navy.

S-Ts IN THE ORIENT

The most interesting use of Ryan training planes in wartime service occurred in the Orient. The Chinese ordered large numbers, and they were shipped "knocked down" to Burma. They were then trans-shipped to Loiwing on the China-Burma border, where they were reassembled and flown to the interior of China for extensive training use.

At about the same time, the Netherlands colonial administration prepared to defend Java, Sumatra, and others of its islands in the East Indies coveted by the Japanese. Seaplane as well as landplane STM trainers were ordered in the largest contracts for the S-T type received to that date. By early 1941, Ryans were being delivered by cargo vessels at Surabaya, Java.

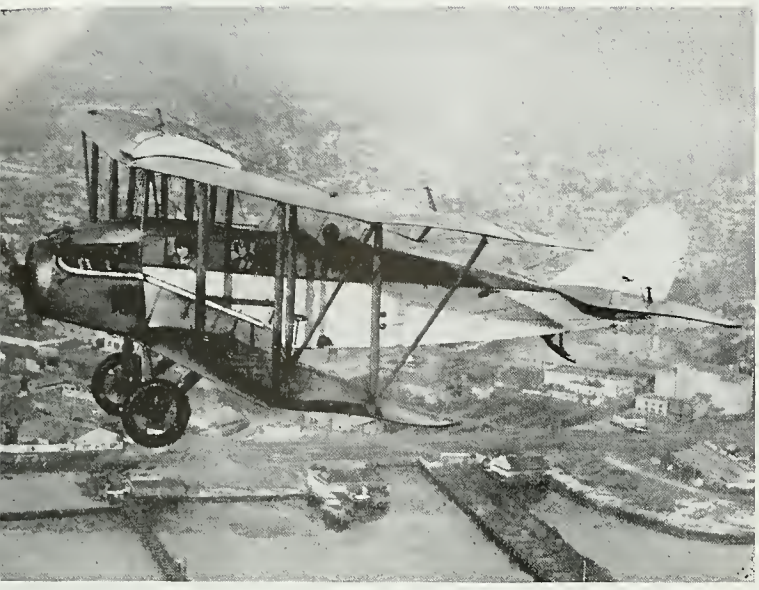
Under the pressure of the emergency, they were used for primary, basic, advanced and blind flying training. Students went directly from the STM land and seaplane trainers to multi-engine equipment.

Whenever Japanese raids interrupted training, the Ryan seaplanes were flown from the Morokrembangan naval air base at Surabaya to nearby rice paddies, which were flooded to provide emergency landing fields. There they were camouflaged by palm leaf covering and saved to fly another day. While in training, students were used as aerial spotters, and more than once unarmed Ryan STMs engaged in "dogfights" with enemy fighters, depending entirely on out-maneuvering them to escape.

The Japanese later captured many of the land planes based at Bandoeng and used them to train their own fliers in aerobatic maneuvers and formation flying. Ryans that were saved and shipped to Australia were taken over by the Royal Australian Air Force for flying practice.

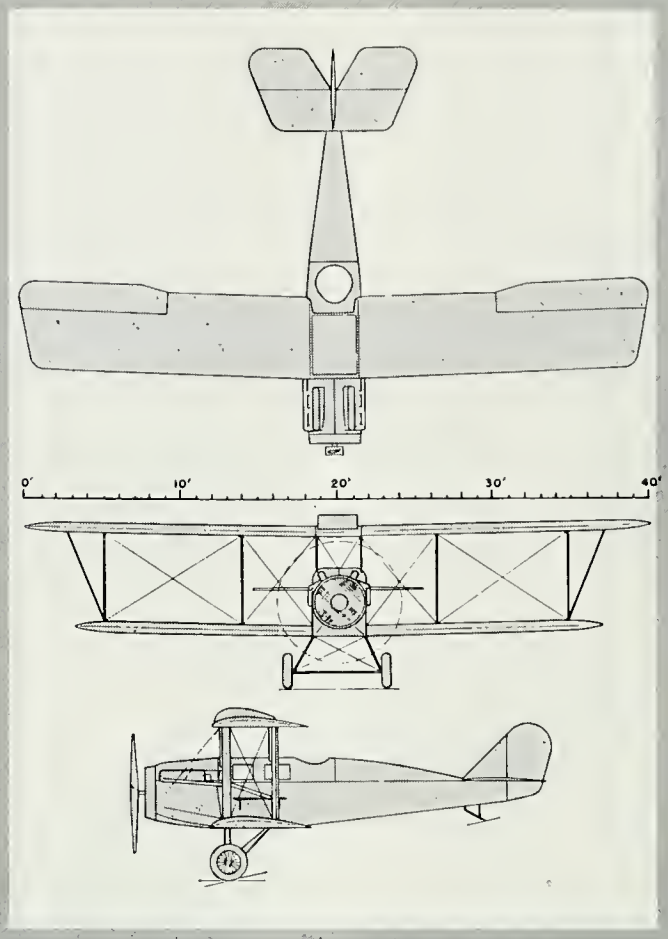
Today with Q-2 jet propelled pilotless target planes in the midst of an extensive flight test program and other planes in development, Ryan engineers are looking ahead to still more revolutionary Ryan military aircraft to carry on a proud tradition.

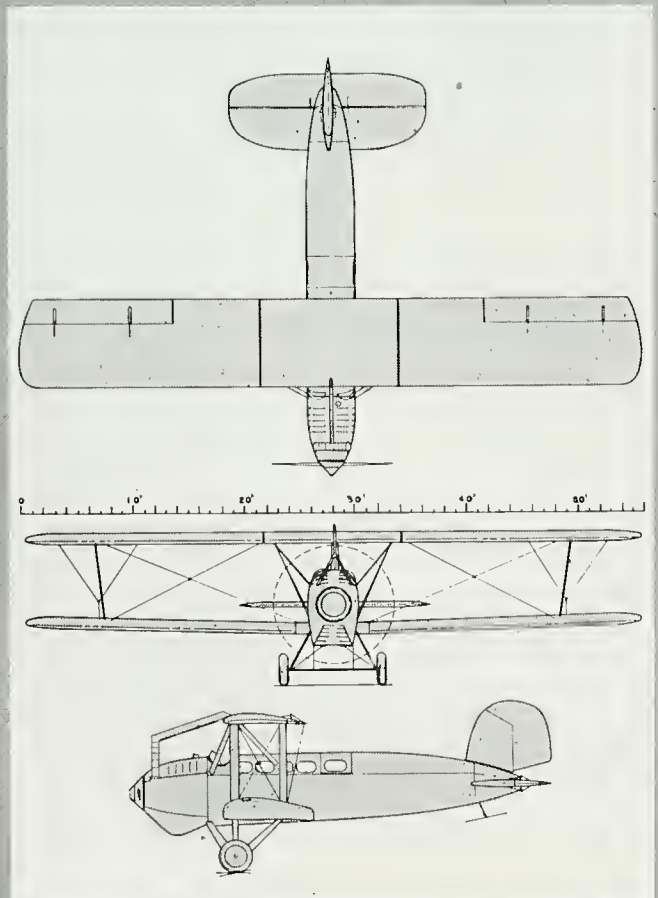
RYAN PLANE PORTRAITS



1925 Ryan-Standard

First in the long line of Ryan airplanes was this conversion of World War I surplus Standard biplanes, which were redesigned and rebuilt into five-place cabin jobs. Old engines were replaced with 150 horsepower Hispano-Suiza power plants. Renamed Ryan-Standards, these reliable passenger biplanes were used to pioneer "Los Angeles - San Diego Air Line" which inaugurated regular Ryan Airlines, Inc., service in March, 1925.



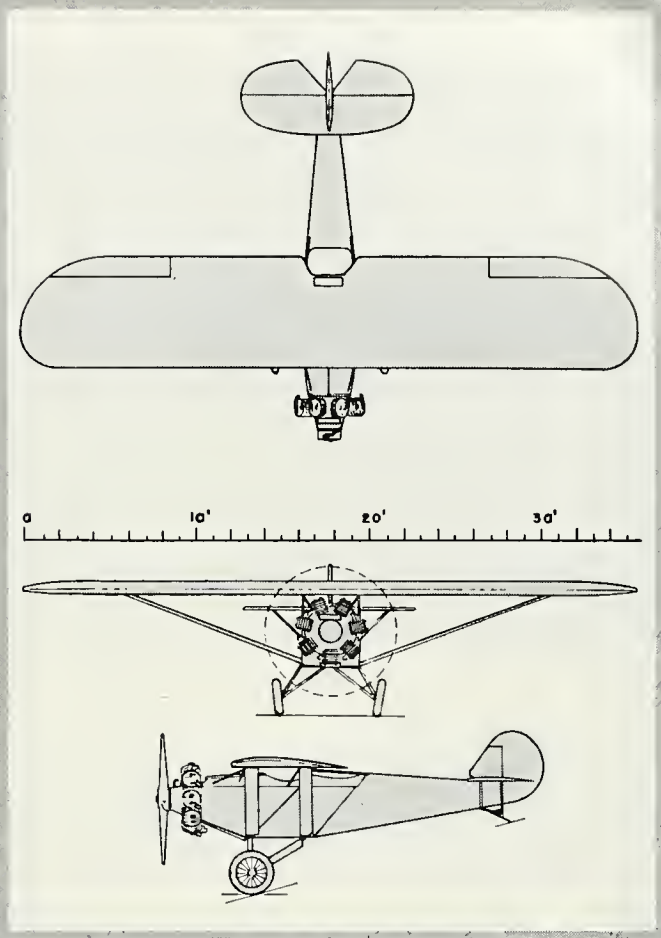


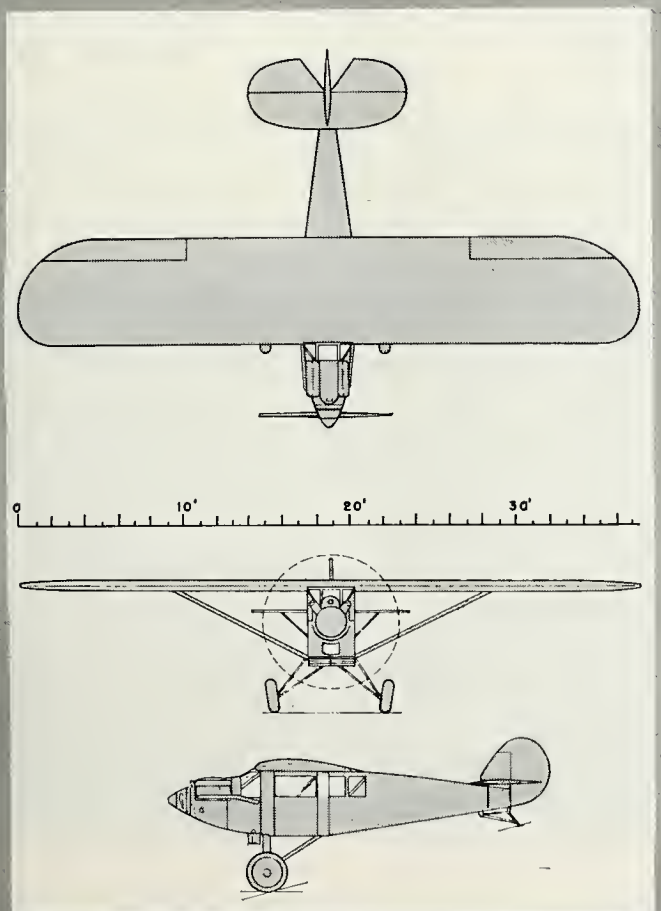
1926 Cloudster

Second plane redesigned by Ryan organization was Cloudster, first of many famous planes built by Donald Douglas. Needed for the expanding Ryan Airlines operation, the Cloudster had three open cockpits, two holding three people, while the pilot's cockpit held two more passengers. The plane was rebuilt in Ryan's shops with cabin to accommodate ten passengers, with cockpit forward for pilot and mechanic, or co-pilot.

1926 Ryan M-1

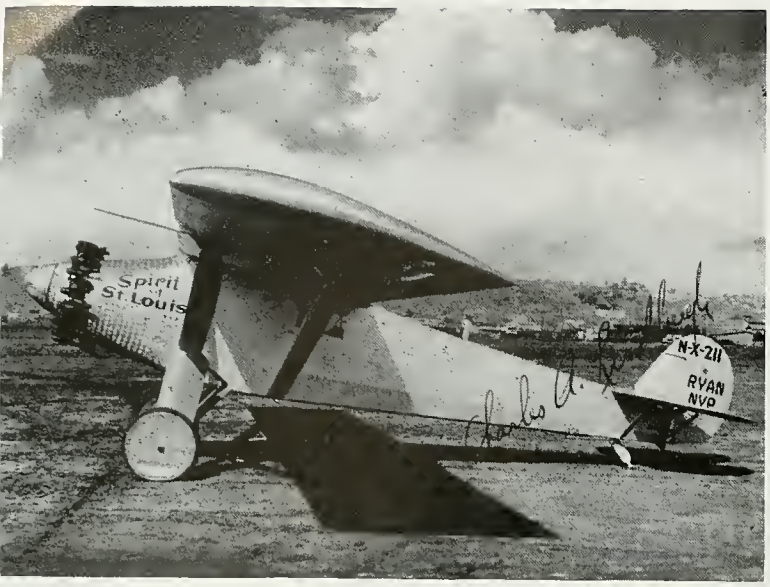
Pioneer mail plane and the first volume production monoplane in the United States was the M-1, the first airplane which in design and construction was Ryan's own creation right from the start. High-wing and three-place, the M-1 was powered by Wright Whirlwind 200 h.p. engine, but also available with Hispano-Suiza, Super Rhone and Curtiss OX-5 power plants. First M-1s were used on mail routes of Pacific Air Transport.





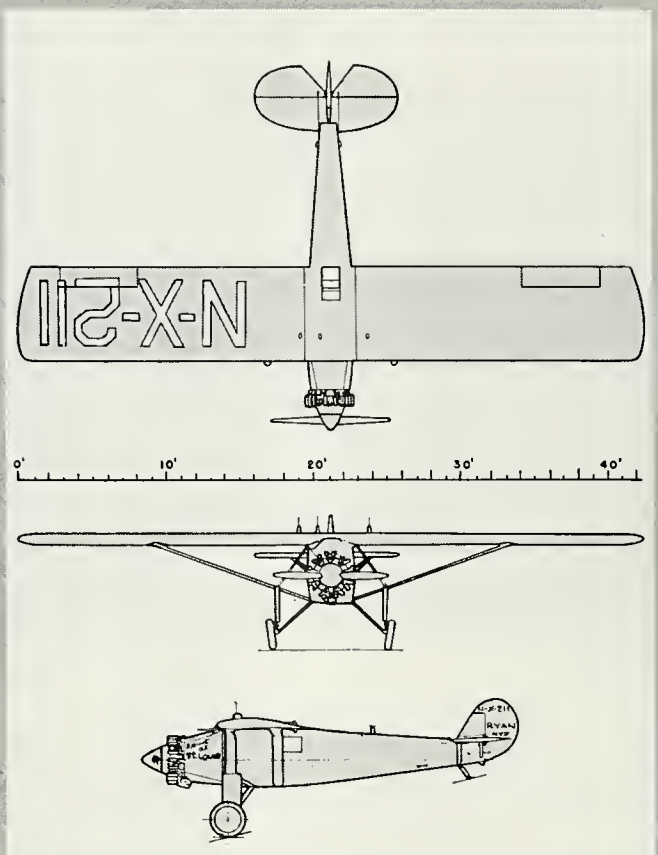
1926 Ryan M-2 Bluebird

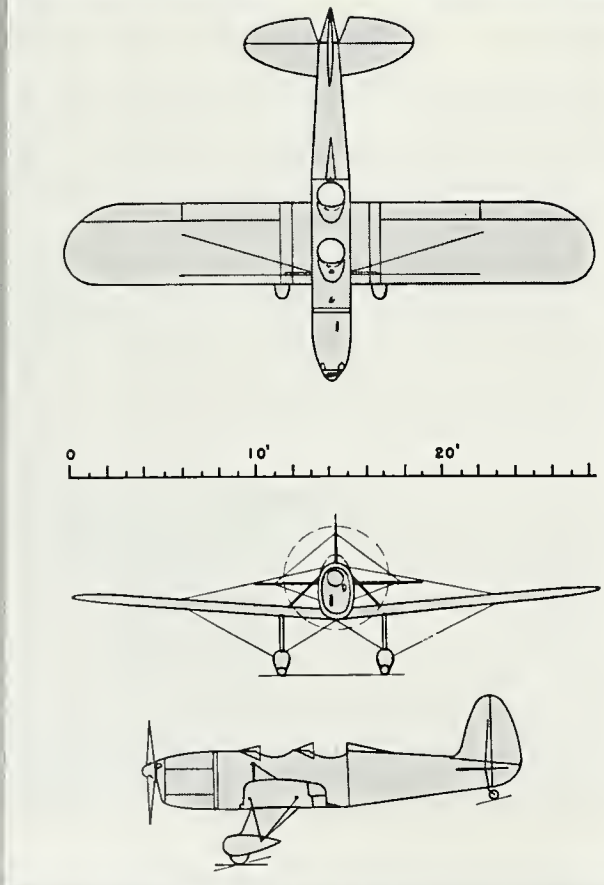
An advance version of the M-1 was the M-2 "Bluebird" first cabin monoplane to be built by the budding Ryan manufacturing organization. This series of monoplanes, still further refined in design and appointments, became well known in later years as the "Broughams," first of which was built on special order for famed speed flier Frank Hawks. Broughams pioneered air service in Latin America, Canada, many other remote spots.



1927 Ryan Brougham

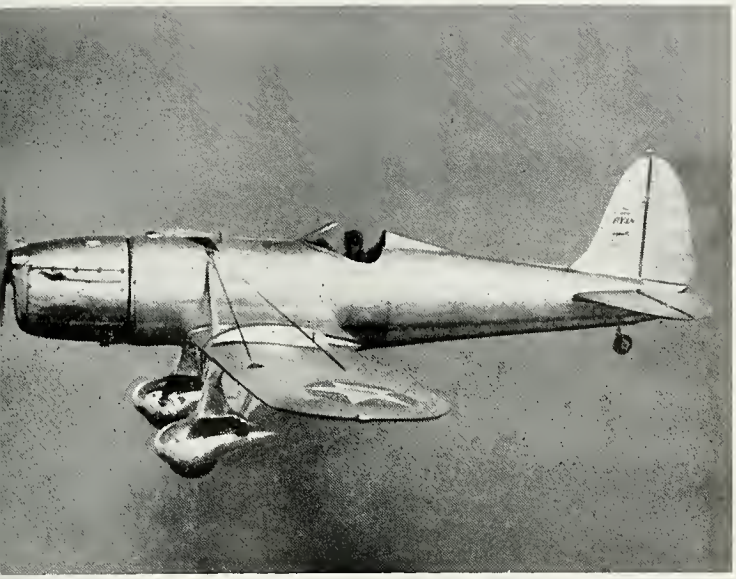
Most famous plane in aviation history was the Ryan "Spirit of St. Louis" monoplane built on special order for an unknown airmail pilot named Charles A. Lindbergh. Engine: 223 h.p. Wright J-5-C. Span was 46 feet; length 27½ feet; wing area 319 square feet; gross weight 5250 pounds; range 4110 miles. Plane took off with 450 gallons, flew non-stop New York to Paris, a distance of 3610 miles, in 33½ hours May 20-21, 1927.





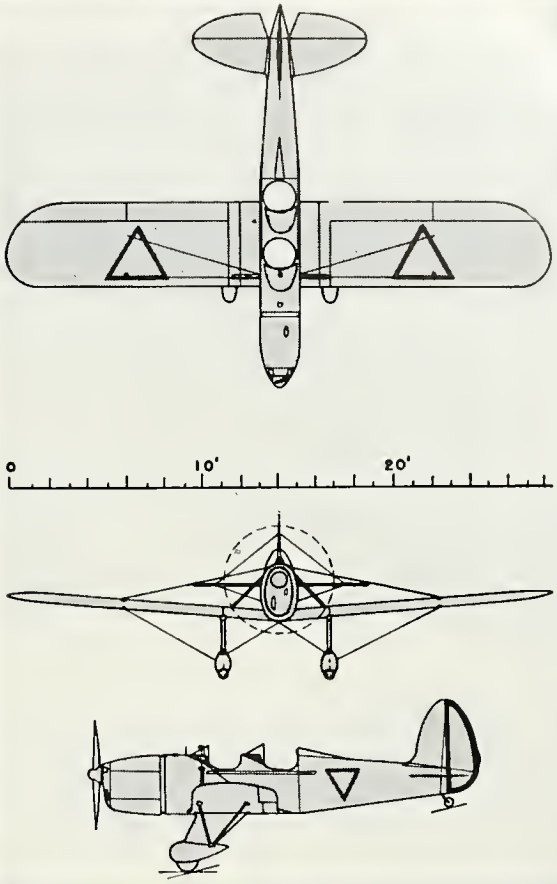
1934 Ryan S-T

Few planes have won the popular approval and acceptance enjoyed by the Ryan S-T series of monoplanes, originally developed for sport-flying and pilot training. First models were powered with 125 h.p. Menasco in-line engines; later 150 h.p. supercharged engines were installed. S-Ts cruised at 125 m.p.h.; landed at 42 m.p.h. Construction featured metal fuselage, low-wing design, streamlined wheel fairings, flaps to shorten landing.



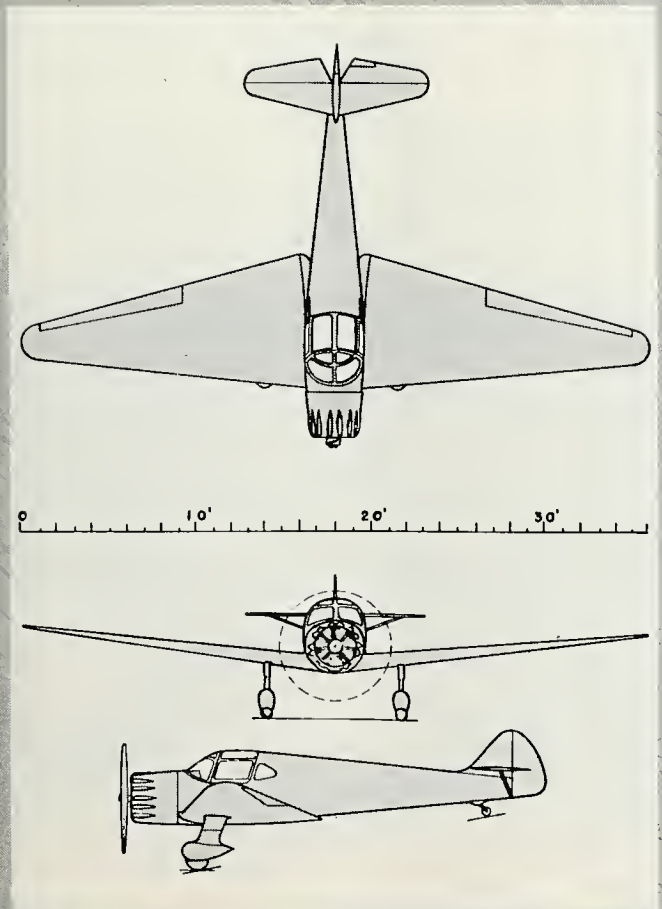
1938 Ryan STM

Foreign countries soon adopted Ryan S-Ts for military training. Planes for Honduras Air Force, shown here, were single-seat and mounted machine guns in wings. Mexico and Guatemala also used the 150 h.p. military STMs. Later model, STM-2E of 1941, based on U. S. Army PT-20 version of basic S-T, was exported in large numbers to Netherlands East Indies and to Republic of China, training fliers for combat against the Japs.



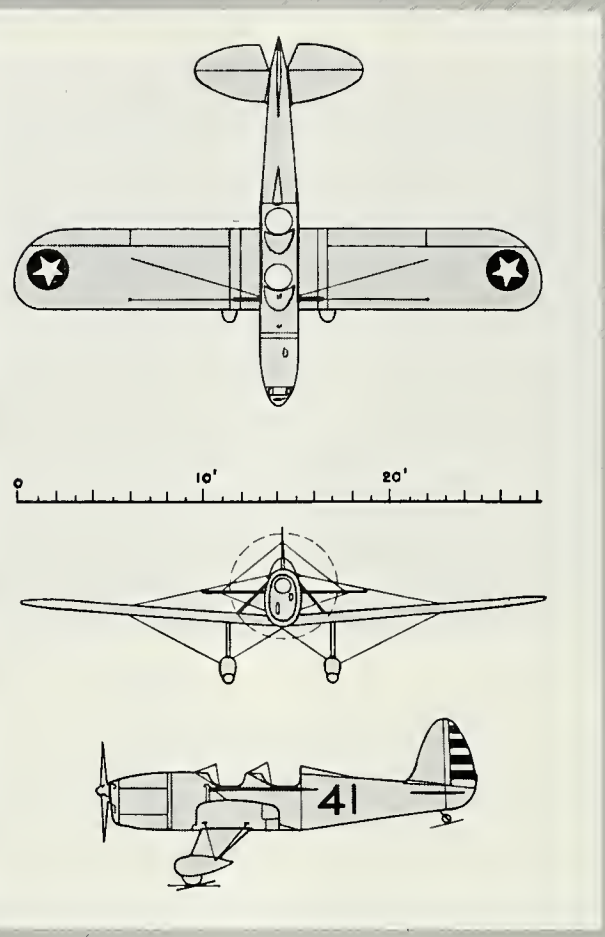
1938 Ryan S-C

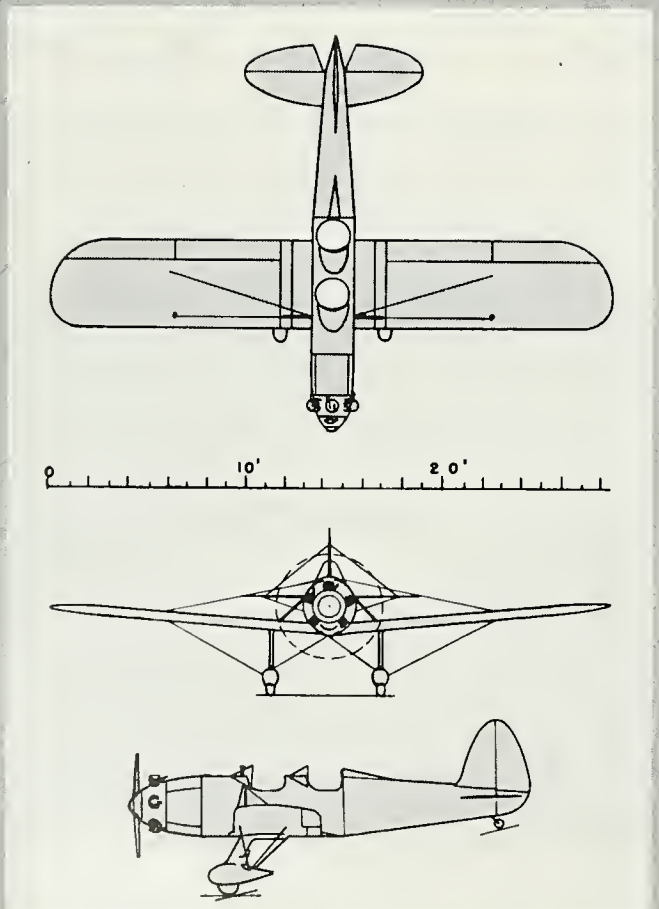
In design, engineering and manufacture, the Ryan S-C was the first private-owner cabin plane to take full advantage of all-metal construction and full-cantilever low-wing efficiency. Powered with 145 h.p. Warner radial engine, the S-C cruised at 135 m.p.h., had top speed of 150 m.p.h. Wing span was 37 feet 6 inches; length 25 feet 5 inches Prototype of the S-C had a 150 h.p. Menasco in-line engine, the same as S-T models.



1939 Ryan PT-20

First low-wing planes ever used by U. S. Army Air Force for primary instruction of aviation cadets were military versions of popular Ryan S-T sport trainer. Both the PT-16 and PT-20 were powered with Menasco 125 h.p. C-4 in-line engine. Principal difference in two models was the larger cockpit opening of the PT-20, by placement of longerons on fuselage exterior, to make it easier to enter the trainer with a parachute.



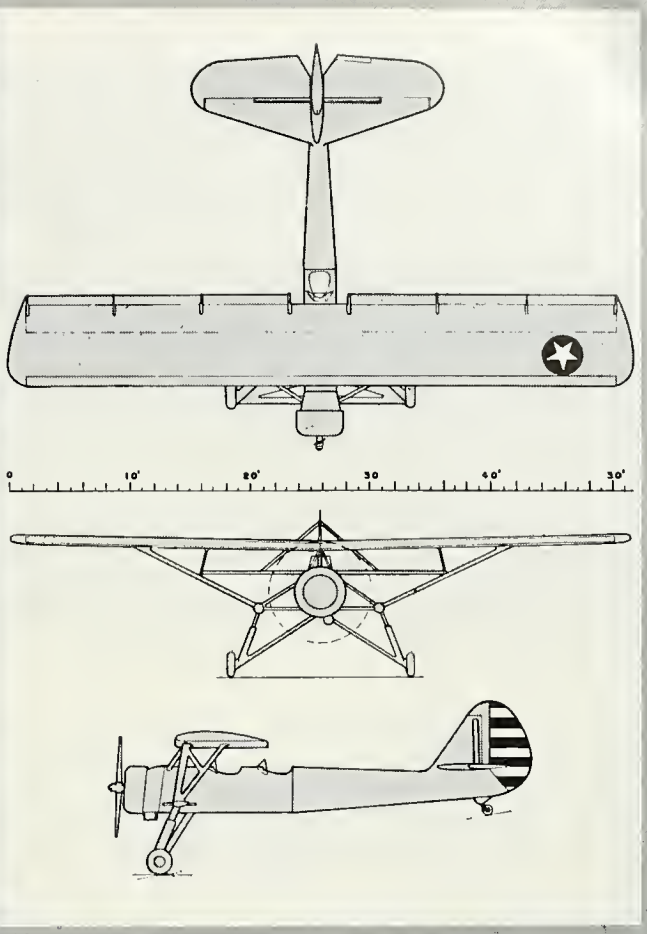


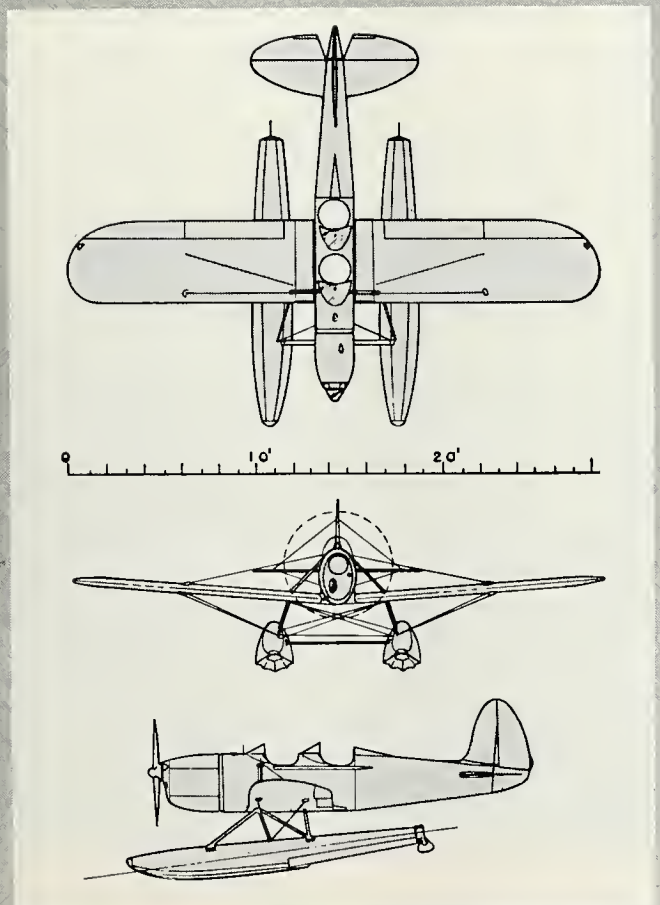
1940 Ryan PT-20A

This version of Ryan primary trainer was the basic PT-20 with a Kinner 125 h.p. radial engine installed in place of the in-line Menasco. There was also a PT-16A model converted to Kinner engines from original PT-16s. The P-T series of Ryan trainers gained wide recognition for unexcelled flying characteristics. At minimum cost, they gave experience in low-wing planes, such as later flown in advanced training.

1940 Ryan YO-51 Dragonfly

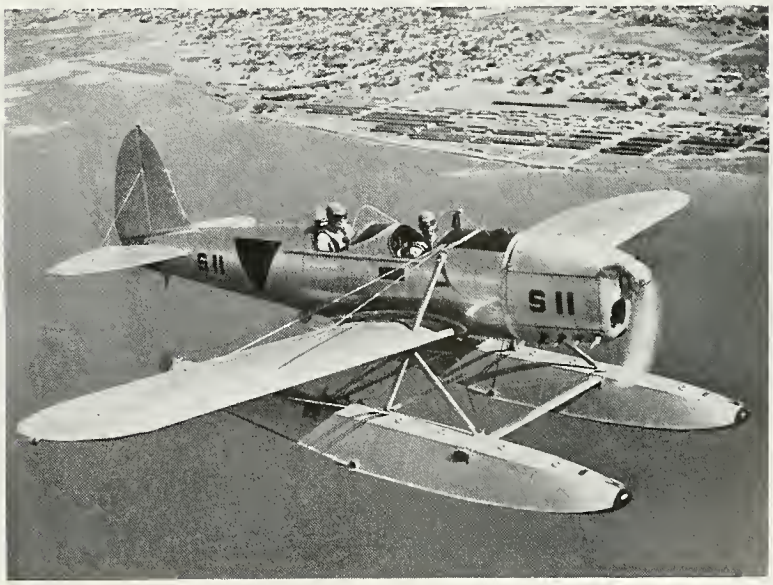
Unusual flight characteristics and sensational ability to make short, steep take-offs and nearly vertical landings, featured the Ryan YO-51 "Dragonfly" short range observation plane. Developed for liaison work for the U. S. Army, the YO-51 was capable of clearing a 50-foot obstacle 350 feet from take-off, and maintaining minimum speed of 32 m.p.h. Slots were along entire leading edge; flaps along entire trailing edge of wing.





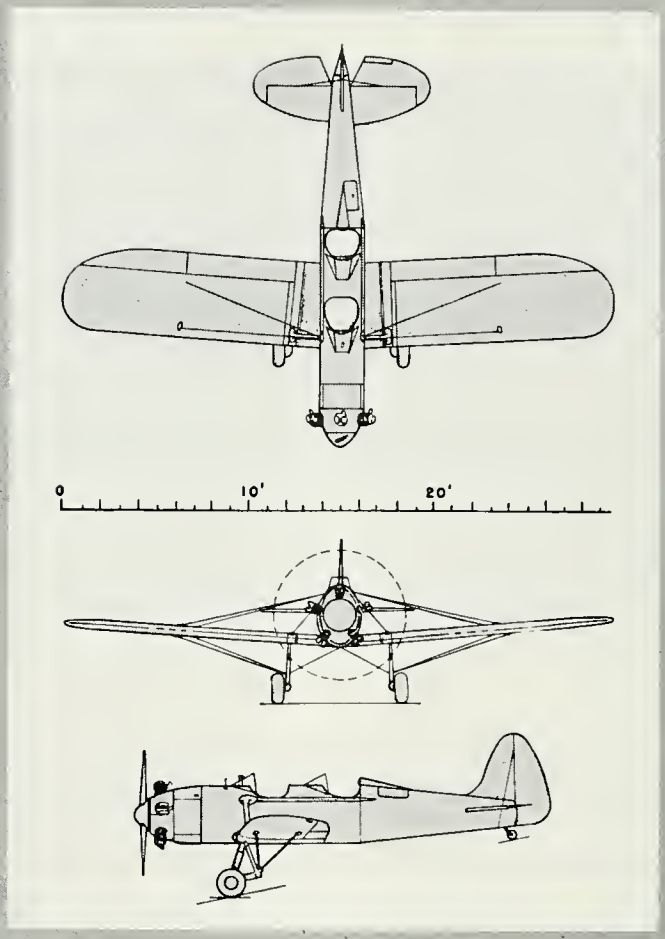
1941 Ryan STM-S2

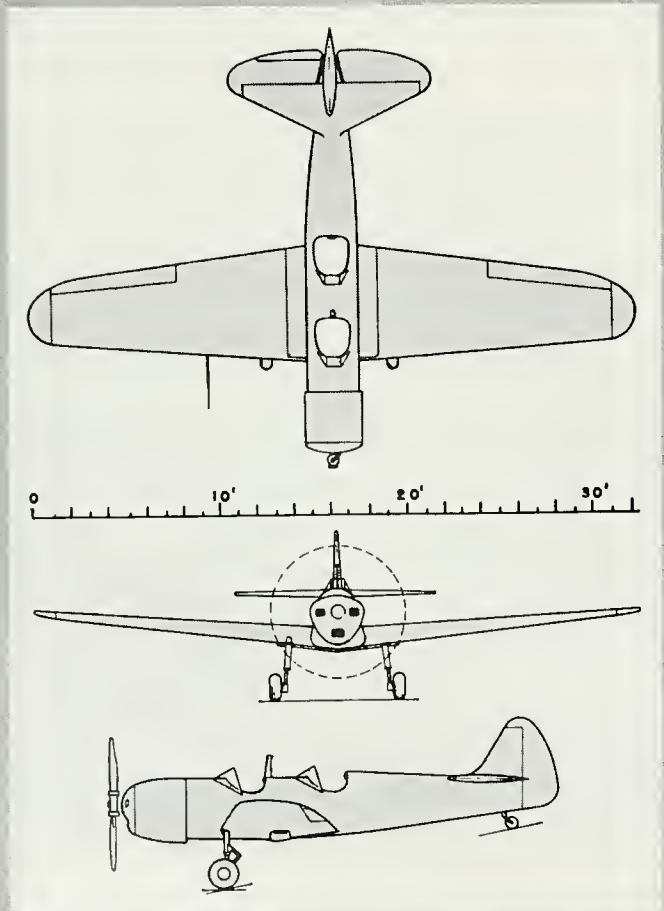
For Netherlands East Indies Navy, Ryan built 50 seaplane versions of its basic PT-20 military trainer model. Powered with Menasco 150 h.p. C-4S supercharged in-line engines, the seaplane trainers were operated from naval base at Surabaya, Java, known to U. S. flight instructors as "Little Pensacola." Refugee Hollanders trained on STM-S2s then went direct to twin-engine patrol boats with Dutch squadrons of RAF Coastal Command.



1942 Ryan PT-22 Recruit

Largest number of trainers of any one model built by Ryan were 1000 PT-22s for U. S. Army, some of which were later reassigned to Chinese Air Force. PT-22 had 160 h.p. Kinner radial engine. Similar models, the PT-21 Army trainer and NR-1 Navy trainer, had 132 h.p. Kinner engine and landing gear wheel fairings. These planes were commercial model ST-3 and widely used post-war for civil flying. Cruising speed 116 mph, landing 54 mph.



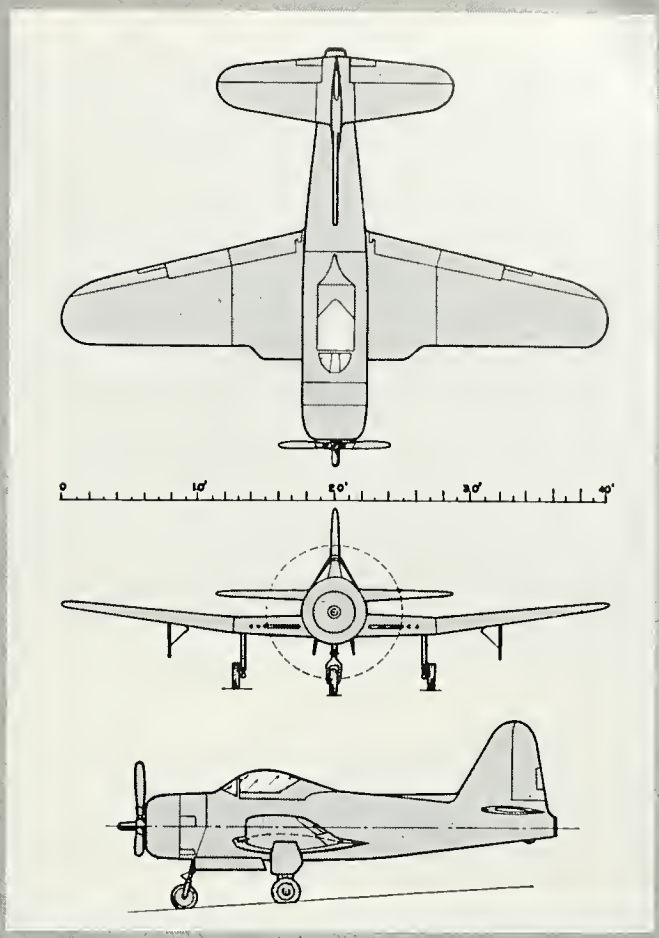


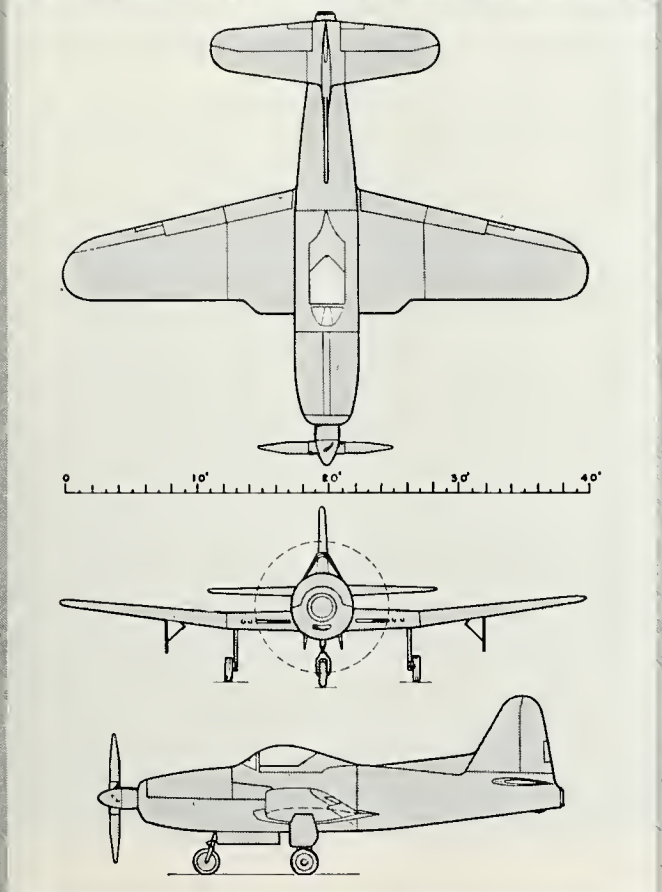
1943 Ryan PT-25

To offset critical aluminum shortage in second year of war, Ryan was asked by Army to develop this plastic bonded plywood primary-basic trainer so maximum amount of strategic metal could be diverted to combat plane production. PT-25 was powered with 185 h.p. Lycoming 6-cylinder air-cooled engine. PT-25 cruised at 135 m.p.h., had top speed of 150 m.p.h., landed at 54 m.p.h. and had 1600 feet-per-second rate of climb.

1945 Ryan FR-1 Fireball

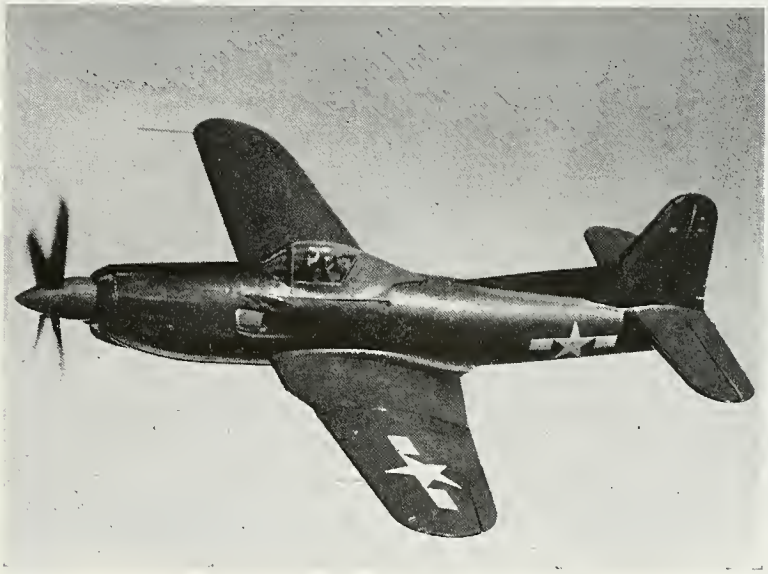
World's first jet-plus-propeller airplane and first plane of U. S. Navy to use jet propulsion was the Ryan FR-1 Fireball. Front engine was Wright Cyclone 1300 h.p. piston type, while General Electric I-16 of 1600 lbs. thrust was installed in aft fuselage. FR-1 could operate on either engine alone and used two power sources together for peak performance. Plane was very maneuverable and had high sustained rate of climb.





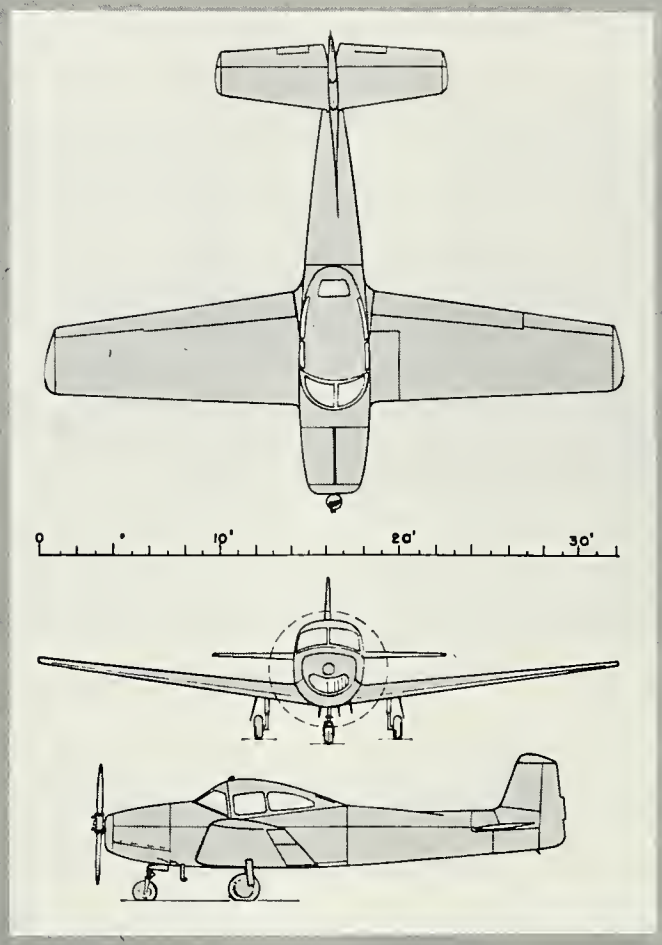
1946 XF2R-1 Dark Shark

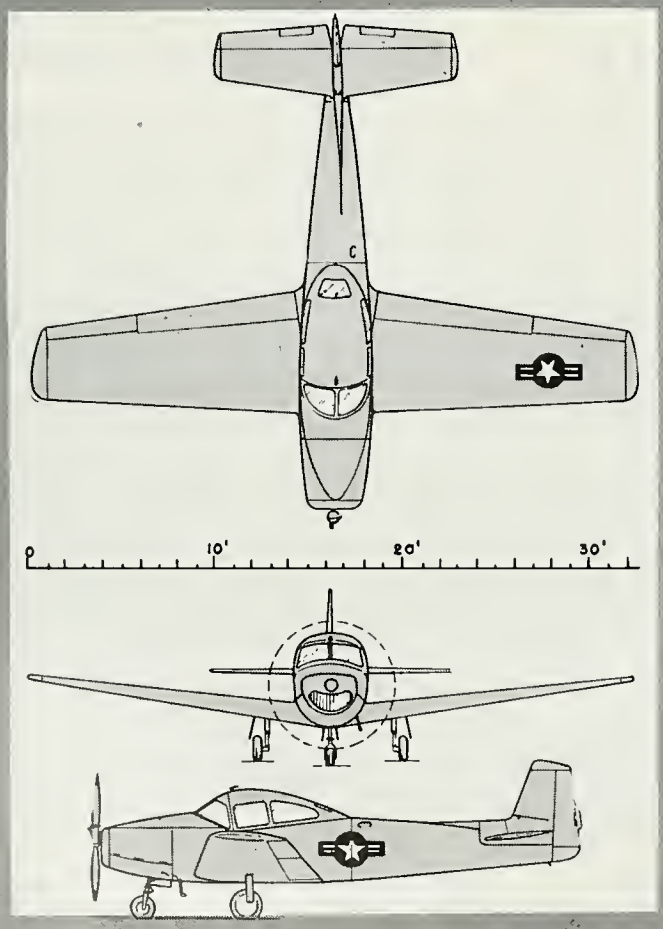
Another composite-engined Fireball was XF2R-1 "Dark Shark," all-turbine Navy research plane with G.E. TG-100 turbo-prop in nose replacing piston engine. First Navy plane to use gas turbine turning a propeller, XF2R-1 was in 500 m.p.h. class. New nose section of XF2R-1 increased Fireball length by four feet. Greater vertical fin area was provided by dorsal fin. XFR-4 model had Westinghouse 24-C jet in place of G.E. I-16.



1948 Ryan Navion

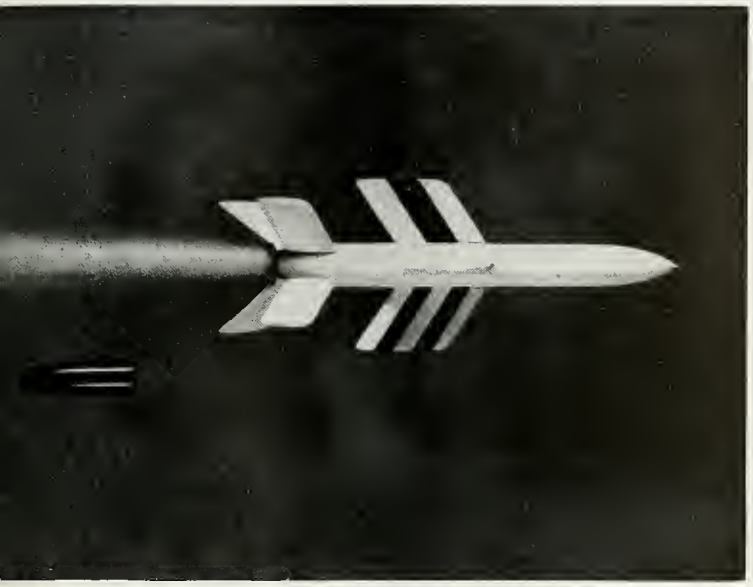
Latest, highest performance Navion is the 170 m.p.h. Super 260 cross-country executive plane. Sparkling performance is provided by 260 h.p. Lycoming engine which shortens take-off and increases climb. DeLuxe Ryan Navion with 205 h.p. Continental engine cruises at 155 m.p.h. No plane combines so many features so well as the big, rugged, fast, safe and easy-to-fly Navion which is favorite for business, pleasure flying.





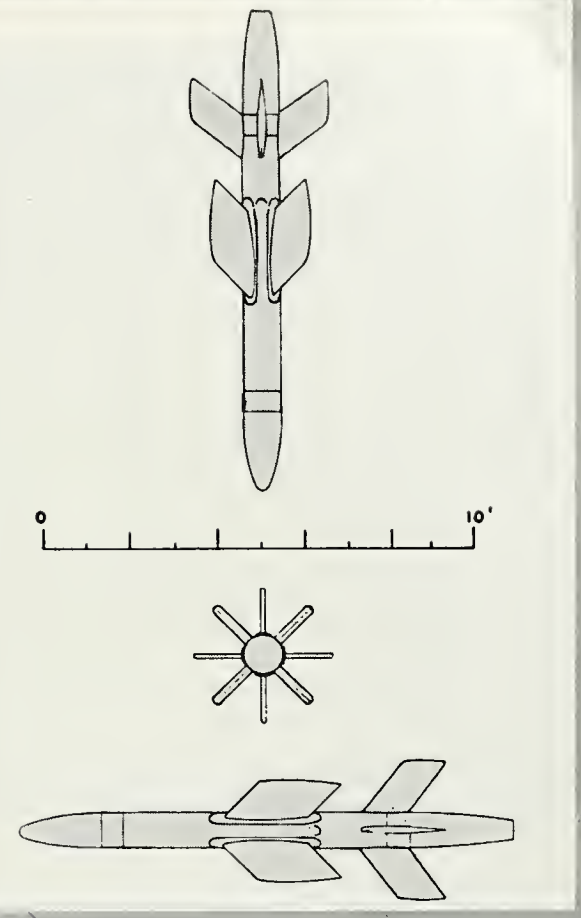
1949 Ryan Navion L-17B

Flying staff car of the Army Field Forces and National Guard is the multi-purpose Ryan Navion L-17B. One of the basic requirements of four-place liaison planes is ability to operate from small, rough strips in combat areas. Rugged construction, large cargo capacity, unexcelled vision have all contributed to Navion's fine record in Korean War where L-17s are used for spotting, and for transport of field commanders and cargo.



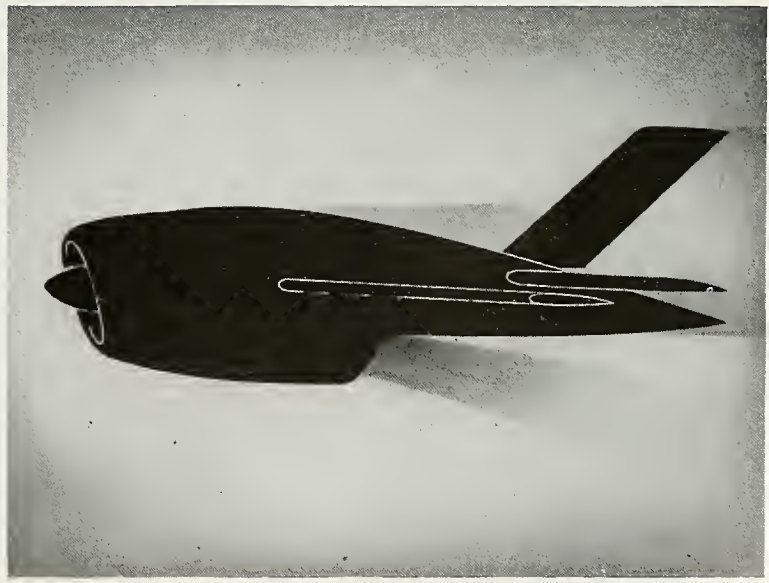
1949 XAAM-A-1 Firebird

First air-to-air guided missile announced by Air Force was rocket-powered Ryan XAAM-A-1 Firebird. Extremely compact, Firebird had complex radar navigational and electronic system. Launched from "mother plane," booster rocket was fired, then when maximum speed was reached, booster was jettisoned and flight rockets took over as missile sped toward target. Ten feet long, Firebird had wings and fins like double cruciform.



1951 Ryan Q-2 Drone

First illustrations Department of Defense has permitted of Ryan Q-2 are silhouette artist's conceptions of this remotely controlled target drone. These high speed, jet propelled pilotless aircraft are less than half the size of jet fighters but have comparable performance. They are designed for combat plane interception problems, and for anti-aircraft and aerial gunnery training by the U. S. Air Force, Army and Navy.



ELECTRONICS LAB — In this carefully guarded electronic research room, Ryan engineers develop the robot "brains" which supplant pilots in uninhabited aircraft. "Intelligence" is rated by complex instruments that chart I. Q.

R & D . . .

JET ENGINE RESEARCH — Rear Admiral J. B. Moss (center) Asst. BuAer Chief and Navy Commanders Cedric Stirling and F. E. Rogozienski are given preview of research project at Ryan jet test cell by President T. Claude Ryan (left) and Ryan engineers Immenschuh and White.

RESEARCH has been defined as the effort to understand relationships which no one has previously known. If this is true, aviation has contributed heavily to this exploration. No other realm of endeavor has overlapped the boundary between the known and the unknown in so many fields of science. Aerodynamics, electronics, metallurgy, thermodynamics, medicine, chemistry, astronomy and others have disclosed new relationships under aviation's pressing quest.

Airplanes are flying twice as fast and twice as high as in World War II. The sonic barrier has been breached and the thermal barrier looms in the future with the problem of how to keep the pilot from "simmering like a beef stew" in 2000-miles-per-hour planes getting serious consideration from design engineers.

Ryan research started a long time ago as aircraft development is measured. Perhaps

it began when Claude Ryan bought a Douglas Cloudster airplane in 1925 and converted it from an eight-passenger, open-cockpit affair into a ten-passenger cabin plane. Certainly, as a basic idea, this was a forerunner of the modern airliner. Or maybe it was when Ryan pioneered the use of low-wing monoplanes, delivering the first that the U.S. Army ever used for primary pilot training, in 1939. In any event, Ryan has always placed emphasis upon research and development and has hung up an impressive record of aeronautical "firsts" in the process.

Unfortunately, the most interesting and dramatic projects which currently fall within the scope of Ryan research and development are necessarily restricted by the requirements of military secrecy. In this category, Ryan engineers are working on unique and challenging ideas which could change many present concepts.

To even a casual observer it must be evident that electronic devices play a key role in modern aircraft and, consequently, in much of the engineering work which Ryan performs. In the creation of both the Ryan Firebird missile and the Ryan Q-2 target plane, highly sensitive electronic systems have been a corollary development necessary to the success of the projects. This is a confidential field which is assuming increasing importance as uninhabited aircraft become more prevalent. More and more, the electronic "brain" is being called

AIR-TO-AIR MISSILE — Endowed with a relentless "intelligence," the Ryan Firebird was first AF missile to "think."

Research and Development . . . the Blueprint of Tomorrow

upon to make the "decisions" which were formerly a pilot's function.

Ryan occupies a leading position in the production of tiny electronic and radar devices, often no bigger than a package of cigarettes, which can "think" in the body of a whizzing missile. Consisting of miniature tubes, transistors and other dwarfed components, these "brains" must be crammed into amazingly small spaces and capable of operating at high temperatures. In an uncanny way, they receive thousands of "messages" per second, "analyze" this information and "pilot" the missile on its streak through space.

For flight evaluation of electronic and radar systems, Ryan engineers have a fleet of three aircraft at their disposal. Indicating the importance of the work to the Armed Forces, a Navy Lockheed twin-engined P2V Neptune and an Air Force North American F-86 Sabrejet fighter have been loaned to Ryan for in-flight testing. A Ryan Navion comprises the third plane of this team. Because of the far-reaching effect of electronic advances, each development that Ryan accomplishes may have innumerable applications in many other companies and industries.

In 1946 Ryan designed and built a jet test cell which is equipped to test the most powerful jet engines and afterburners. Constructed of 18-inch thick concrete and steel armor plate, the massive vault contains a heavily "fortified" control room for observers. Through a glass-covered slot, Ryan engineers can watch the behavior of earth-bound jet engines as they blast a turbulent wake of flames and heat. The test cell serves a dual function in evaluating both new designs and metals.

In 1949, Ryan announced completion of an important pioneering project—successful research on the first air-to-air guided

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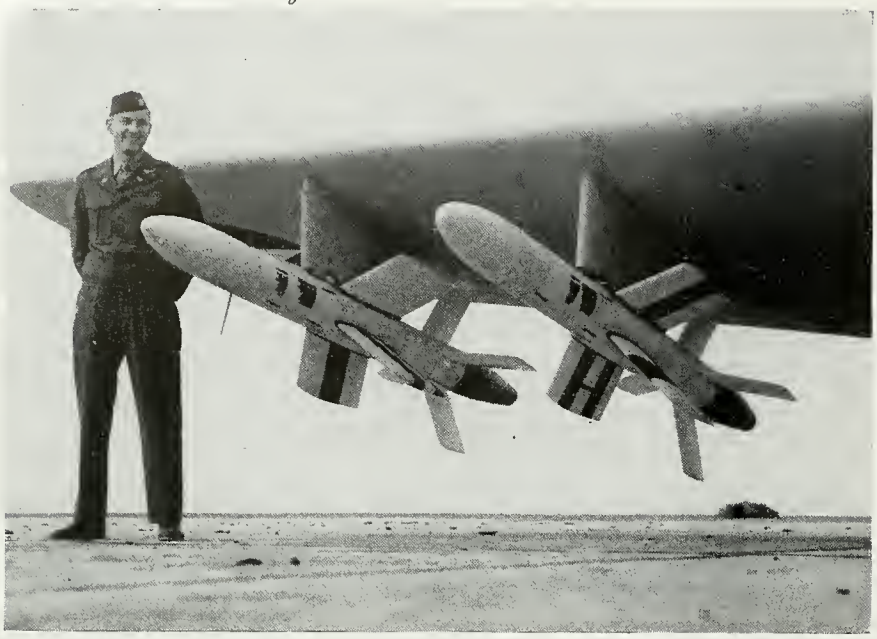
F-86— Ryan uses F-86 Sabrejet fighter to test new electronic devices.

P2V— Navy P2V Neptune is also loaned to Ryan for in-flight research.



FIREBIRDS — Slung under the wing of a North American F-82 "mother" plane, two Ryan Firebird missiles await take-off time at Alamogordo, New Mexico rocket range. Special parachutes recover test missiles, undamaged.

missile for the Air Force. The result of more than two years flight testing, this 10-foot-long, rocket-propelled projectile was virtually a fragmentation shell endowed with human "intelligence." Designated the Ryan XAAM-A-1 "Firebird" it was designed to track enemy aircraft by means of complex radar navigation and electronic systems.

In operation the Firebird was launched from a high speed "mother" plane and set to "home" on its air borne target. It was fired by a self-contained booster rocket in its tail; then, when maximum speed was attained, the booster rocket was jettisoned and a series of flight rockets sped the missile to its tracked target.

Wings and tail of the Firebird were in the form of a double cruciform, the wings having an × attitude and the fins a + attitude when in level flight. The four vane-like wings, of about 3-foot span, were located midway on the projectile. Two feet behind were the four tail vanes. Both wings and tail surfaces served to control flight of the missile.

Working with Air Force technical personnel, Ryan engineers conducted extensive Firebird firings at the testing range at Alamogordo, New Mexico. North American F-82 and Douglas B-26 planes were used as launching platforms. From these experiments the Air Force and aircraft industry gathered valuable design data which was used in the improvement of air-to-air missiles. Ryan's present electronic projects are an extension of work originally done on the Firebird.

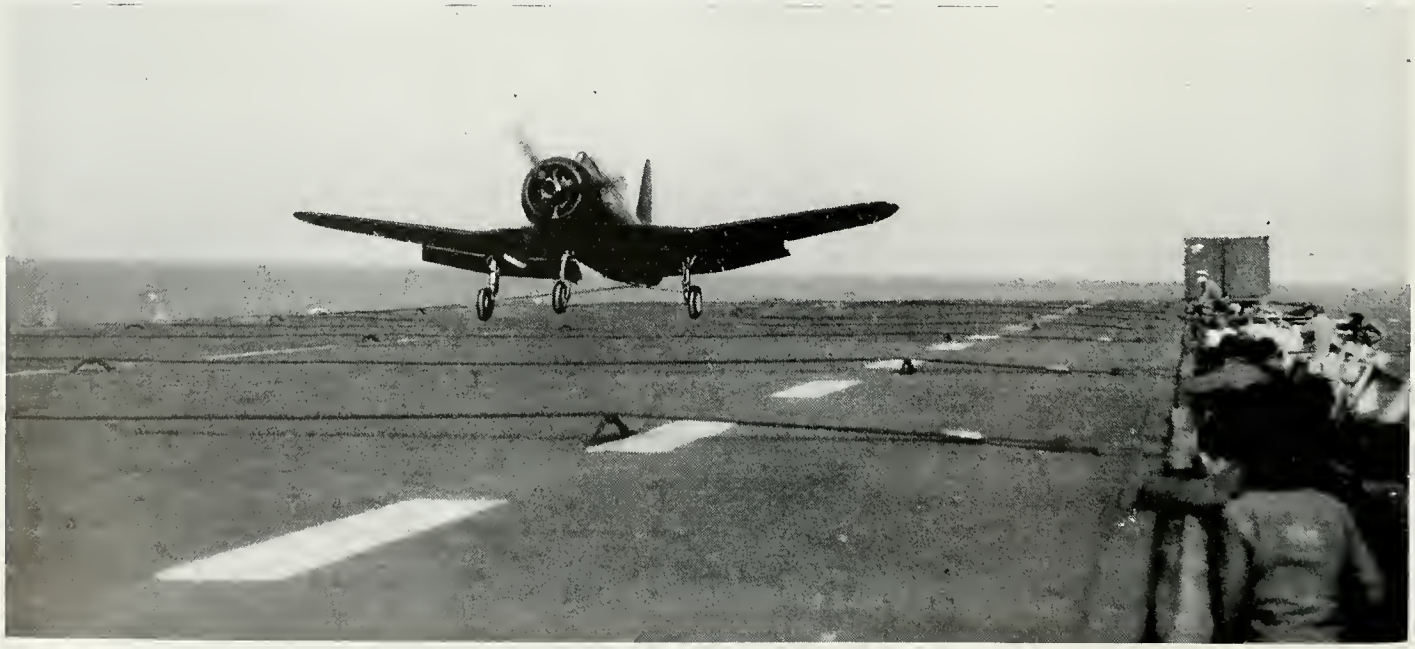
Shortly after the completion of the Firebird project, Ryan developed detail plans for another pilotless aircraft — a high speed jet propelled target plane. After a major competition, Ryan was awarded a contract to build the Q-2 target drone and is continuing its development at this time.

In retrospect, the Ryan FR-1 Fireball Navy fighter is one of the most striking evidences of Ryan aggressiveness in tackling jobs never done before. In fact it was labeled a "can't be done" project by some aeronautical authorities when it was first conceived by Ryan and Navy engineers.

In 1943, jet propulsion was a nebulous phrase cloaked in military secrecy. Three months before, the first American jet plane had flown and the Navy wanted to adapt the promising, new form of propulsion to carrier operations. But, because the engines developed little thrust at low speeds, it was impossible to take a jet plane off a carrier deck with engines of that period.

Navy and Ryan engineers conceived the

TRICYCLE GEAR ON CARRIER — All eyes are glued on the Ryan FR-1 Fireball as the sleek jet fighter is cable-arrested aboard a carrier. The Fireball pioneered use of tricycle-geared planes on carrier decks.



idea of building a carrier plane which would combine the advantages of both piston engine and jet power plant in a single configuration. The conventional engine and propeller would be used for cruising and for low-speed operations including take-off and landing. The jet would be switched on for high-speed performance, especially in combat maneuvers.

This was an ambitious undertaking because the plane would have to meet all of the requirements of a carrier-based aircraft and contain the equipment and facilities for operating two basically different engines in a light-weight design. Also, no one knew what problems would be encountered when these two types of power plants were teamed together.

Ryan started to work on the revolutionary idea and the result was crystallized in 1944 in the form of the world's first composite-engined aircraft. Undoubtedly, one of the most pioneering designs ever attempted, the Fireball broke many precedents. With the gear for two engines and a Navy fighter pilot packed within its 10,000-pound contour, it was probably the most compact plane built.

Because it was the Navy's first jet-propelled plane, the Fireball pioneered the use of jet aircraft on carriers. Of almost equal importance, it was the first tricycle-geared aircraft qualified for carrier operations. This type of gear, now a familiar sight on carrier decks, gave the Fireball improved dynamic stability and kept the searing jet blast off the deck. Careful engineering and research were required to evolve successful arresting and catapulting gear and techniques for this entirely new design.

To enable Navy pilots to fly efficiently on the jet engine alone, the Fireball was equipped with the first full-feathering propeller used on single piston-engined aircraft. Previously used only as an emergency measure on multi-engined aircraft, this propeller could be feathered to head the blade edges into the air flow.

Many new manufacturing techniques

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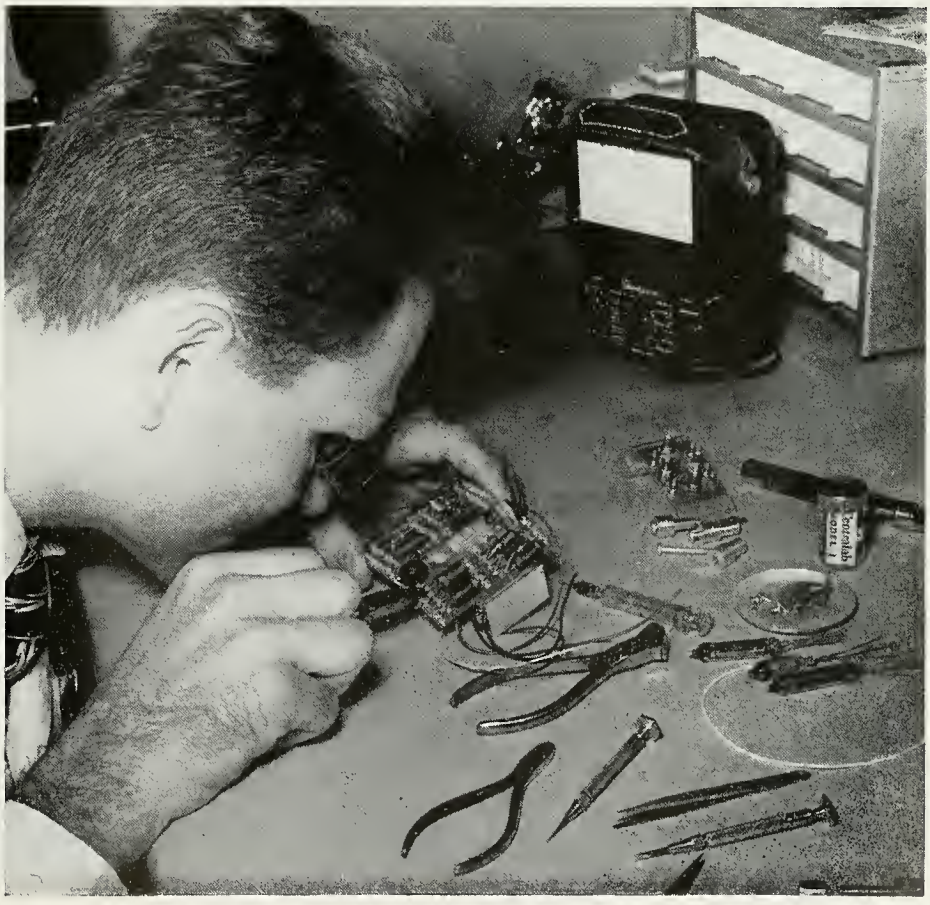
SUBMINIATURE — Jeweler's tools are used to assemble the tiny packaged radar circuits which Ryan engineers cram into an amazingly compact space. Dwarfed parts and peanut tubes have been developed for these applications.



were incorporated in the Fireball's production. It was the Navy's first production plane to be flush-riveted on its entire exterior. This insured a smooth surface which minimized parasitic drag. The FR-1 was the first plane to take full advantage of the benefits of post-aged aluminum. By heating Alclad 24-S to 365° F. for ten hours, it was possible to enhance its tensile strength by a full twenty percent. However, this reduced the material's resistance to corrosion. Ryan laboratory chemists devised an anodizing and priming procedure which restored the lost corrosion protection. As a result, substantial weight was saved in the Fireball's design by utilizing thinner-gauge, high-strength Alclad.

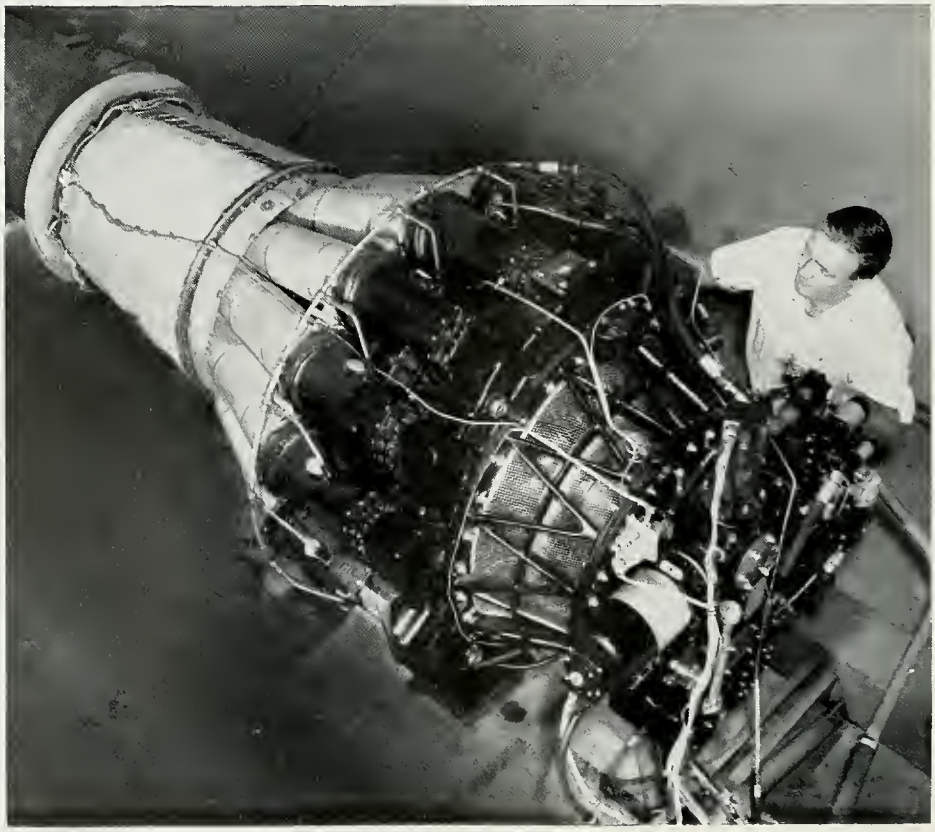
TURBO-PROP — First Navy turbo-prop was Ryan XF2R-1 shown with propeller feathered. XF2R-1 pioneered use of propeller as air brake to speed descent.

A later version of the Fireball series, the XF2R-1, substituted a General Electric TG-100 turbo-prop engine for the forward piston-type power plant. This was the Navy's first turbo-prop airplane and the first turbo-prop-powered aircraft to make a cross-country flight. In this airplane, Al Conover, Ryan chief test pilot, performed the first experiments in flattening the propeller blades, in flight, to reduce air speed and steepen gliding angle of a plane having a single propeller. Conover also employed the propeller in reverse pitch to decelerate the Fireball's landing roll on the runway.

With another version of the Fireball, the XFR-4, Ryan pioneered, under NACA auspices, flush-entry ducts for feeding air to the buried jet engine in the fuselage. Faired into the sides of the fuselage, they eliminated wing ducts and air scoops.

Many Ryan research projects of yesterday have become commonplace sights of today. Tricycle-geared, jet planes are flying from carriers, turbo-prop power plants are being perfected and guided missiles are coming into their own. Now, Ryan is working on new problems to get the answers for developing the aircraft of tomorrow.

JET TEST CELL — An Allison J-33 jet engine is readied for research work in the Ryan jet test cell by Edward Sly, test engineer. Power plants and metals are subjected to test in the massive concrete and steel structure.



1921 — Forest Fire patrol over the western forests was T. Claude Ryan's first duty after completing advanced Army Air Corps training. He is shown beside Liberty-powered de Havilland in which he flew patrols over Northern California and Oregon.

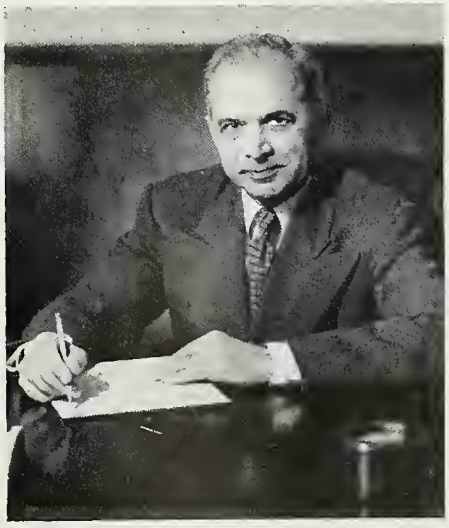
HIS DREAMS TOOK WINGS

Early disappointments failed to discourage T. Claude Ryan in quest for company's success

NO firm the size and importance of the Ryan Aeronautical Company could possibly be a "one-man organization." Yet, as in so many typically American success stories, the initiative of one man—its founder-president, T. Claude Ryan—has given dynamic leadership to the enterprise for 30 of the 50 years since the Wright Brothers made their first flight.

On a Kansas prairie . . . in a Southern California orange grove . . . Claude had winged dreams in aviation's infancy—dreams that were not to be denied. His vision was toward the skies from childhood days in Parsons, Kansas.

While other youngsters devoured dime novels, Ryan's appetite for adventure was whetted by stories of such pioneers as the Wright Brothers, Langley, Lilienthal, Farman and Bleriot.

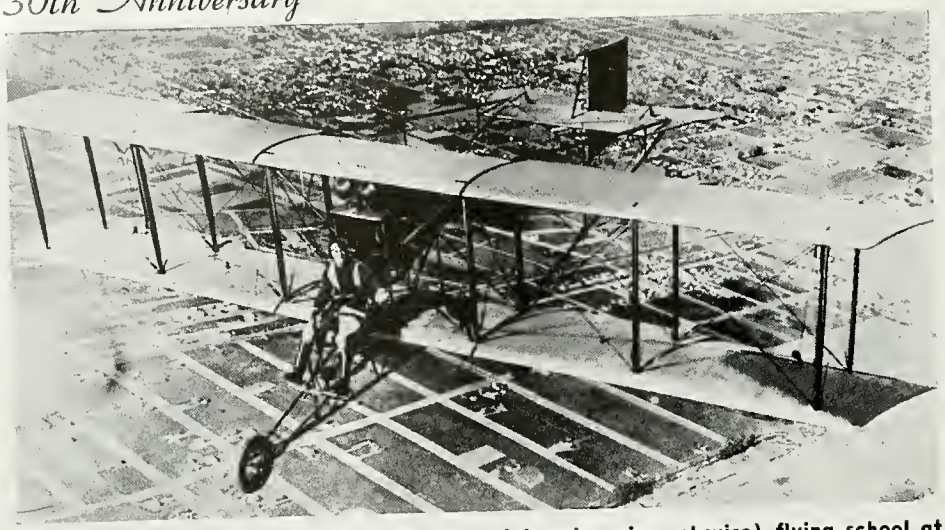


One of the few aviation pioneers still at the head of the company he founded, T. Claude Ryan is pictured in his office at Ryan Aeronautical Company, San Diego.

A deep impression was left on him by an article, "How I Fly," in which the author, now forgotten, told of his experiences in an early Bleriot monoplane. Perhaps it is no coincidence that Ryan later became America's first quantity producer of monoplanes.

He was 13 years old—back in 1911—when he saw his first airplane. Cal P. Rogers was making the first transcontinental flight in a Wright biplane. He chose the Katy railroad as an east-west landmark beyond St. Louis, and flew over Parsons, on the main line. This stirring event sealed the boy's ambition. He was determined to become a flier.

But frustration blocked the path toward his career. The day the United States entered the war in 1917, Ryan



1917 — Ryan's instructor in a shaky (financial and equipment-wise) flying school at Venice, Cal., was Al Wilson, shown above in flimsy airplane of that period.

sought to enter naval aviation. He was only 19, two years under the Navy's minimum age for pilots. The Navy recruiting officer at Joplin, Missouri, sent him home.

At about this time, the Ryan family pulled up its roots and made a new home in a Southern California citrus orchard. The move was providential, for it brought Ryan closer to the "incubator" of both commercial and military aviation.

Within a few days after arriving in California, Claude was in San Diego to visit Rockwell Field, Army aviation center, seeking a chance to fly. The Army, too, told him he was too young, but to "come back in a couple of years."

Well, if military aviation couldn't use him, perhaps he ought to learn about building commercial planes.

Glenn L. Martin, who'd been flying planes he'd designed at nearby Santa Ana, might have an opening. Claude walked into a little shop in Los Angeles and confronted a tall fellow in overalls.

"You Mr. Martin?" Ryan asked.

Glenn L. Martin acknowledged his identity.

"Well, I'm Claude Ryan. Could you use a helper in your shop?"

A slow smile crossed Martin's face. He glanced over his shoulder, peering at a small group of men occupied at benches in the rear of the shop.

"Hey, Doug! Any of you fellows need a helper?"

There was an explosive, good-natured burst of laughter from Donald Douglas, who was to become founder and president of Douglas Aircraft Co., from Larry Bell, now president of Bell Aircraft Corp., and from C. A. Van Dusen, later vice-president of Consolidated Aircraft Corp.

No, they didn't need any helper right now, but they'd be glad to answer his questions about aircraft design.

By this time, Ryan began to realize that he was making absolutely no progress in the aviation world. He had been performing such mundane tasks as driving a laundry route when he decided to strike out boldly and use his own—and his dad's—resources to learn to fly.

With his savings and a loan his father obtained on that season's orange crop, Claude Ryan paid $500 for instruction at a Venice, California, school which operated two airplanes of dubious flight ability. His instructor was Al Wilson, who later was the first of the wing walkers and plane-changers. At this moment, however, Wilson himself had learned to fly only a fortnight previously.

The school, as flimsy financially as its planes were structurally, collapsed the day Ryan made his first solo flight, a two-minute hop that ended with a smashed propeller on landing. It simply cost too much to fix the prop, so the school folded. But not before Ryan left with a letter certifying to his flying "experience."

Thus was the first hurdle overcome. Armed with this precious document, Ryan looked up the Army Air Corps office, and was finally accepted as a flying cadet. But he was destined to cool his heels for a few more months. When he received the long awaited notification to report for duty, the Armistice had just been signed. This was the disappointment to crown all the others. As at Joplin, Missouri, and later at Rockwell Field, when he was told to go home because he was too young, the Army now told Ryan to go home because fliers were no longer needed.

So Claude resumed his formal education. He studied mechanical engineering at Oregon State College, and assiduously read aeronautical books and magazines. One day he saw an announcement that the Air Corps was again accepting applications from civilians.

The answer to Ryan's new application came the summer of 1920, when he was working in an orange packing plant near his home. He was ordered to the Army's only pilot school at March Field, near Riverside, in one of the first groups of flying cadets to be trained after World War I. Ryan was one of three in the class of 75 to receive pursuit pilot ratings.

AFTER advanced training at Mather Field, Sacramento, he was one of a select number assigned to forest fire patrol duty over the western forests—duty that made Claude Ryan a remarkably skillful pilot. He learned to take his Liberty-powered de Havilland in

1911 — Ryan (left) was 13 when he and a friend awaited arrival in Kansas of Cal Rogers on first cross-country flight.

1921 — Emergency landings in improvised fields, such as above, sometimes were necessary during forest fire patrol.

1922 — The first piece of flying equipment of the embryo Ryan organization 30 years ago was this World War I surplus Jenny, which Claude Ryan obtained from Army Air Corps after submitting bid. It is shown here ready for passenger or student flying.

and out of small forest clearings, to skim over mountain peaks at treetop altitude through dangerous cumulus cloudbanks, and to fly in all types of weather.

By the time Ryan's active service terminated in January, 1922, he had earned the piloting ability and technical know-how that were to form the foundation of a spectacular business career.

It began quite modestly. Civilian flying opportunities were strictly limited. There were dozens of applicants for every airmail pilot's job on the Post Office Department's pioneering routes. A man had to make his own way—create his own opportunities.

For months all Claude could find to do was a job as stock handler for an auto supply firm in Los Angeles.

Then in the fall of 1922, he made a trip to San Diego to get in some flying time at Rockwell Field on his reserve commission so as to "keep a hand in" as a pilot. A chance remark by a barber who shaved Ryan before he reported to Rockwell Field changed the course of his life.

The barber casually disclosed that a small landing strip at the waterfront had just been vacated by San Diego's only commercial flier, who at that moment was in the clutches of the law for smuggling Chinese across the Mexican border. Ryan glimpsed an opportunity and seized it. In a few hours, he had negotiated the rental of the precariously small field from the city's Harbor Department, and was on his way toward becoming the owner of a flying service.

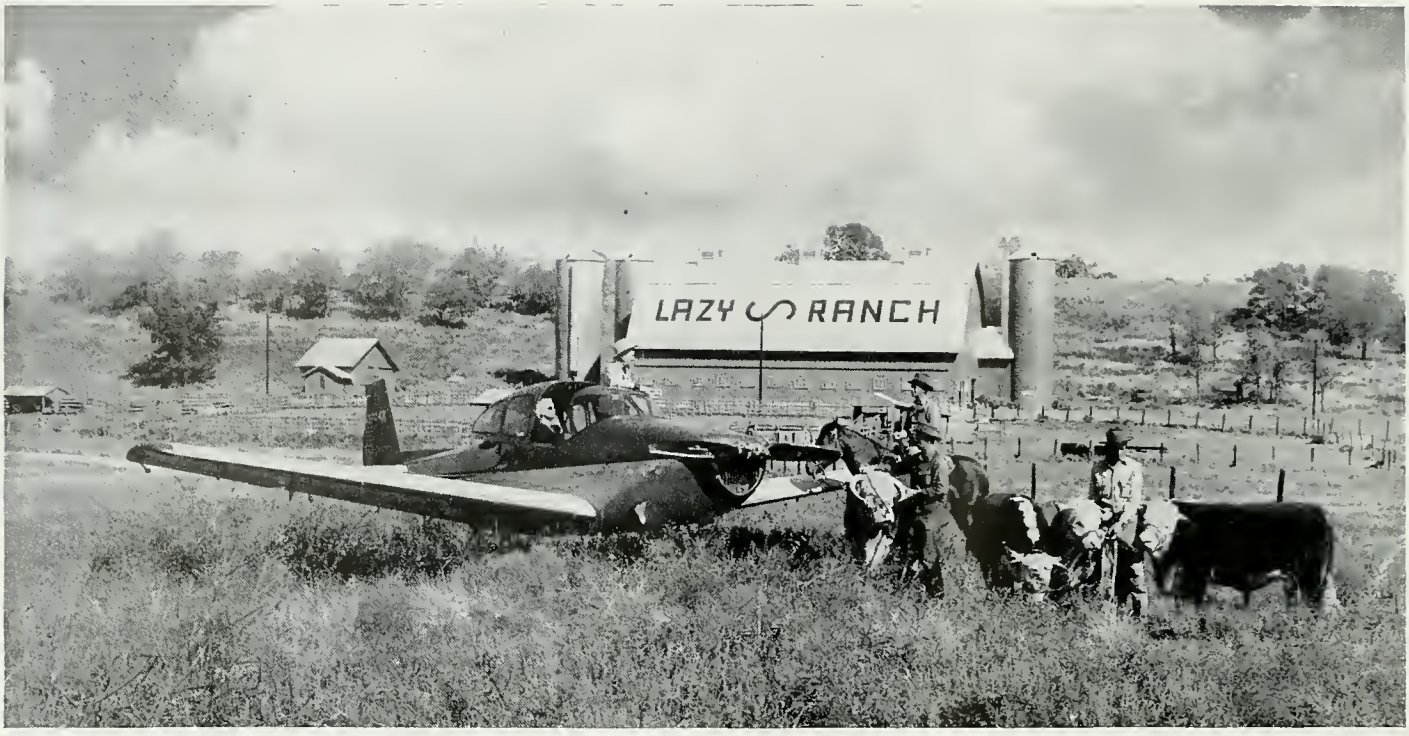
He needed a plane, and there were war-surplus JN4-D Jennies that Major Henry H. "Hap" Arnold, the commanding officer, indicated could be acquired by telegraphing a bid to Washington. Ryan's offer of $400 was accepted. By selling his Model T Ford for $300, and withdrawing all the money he had in the bank—$150—Ryan had enough to buy the plane, pay $25 to mechanics at Rockwell Field to help him assemble it, and start business with a working capital of $25 and a piano box for a tool shed and office.

Twenty years later, during World War II, "Hap" Arnold, as chief of the Air Force, was buying millions of dollars worth of planes from the company Claude Ryan headed and the Ryan schools were training thousands of cadets on contract for the Air Force under Arnold's command.

Slowly at first, but steadily, the little one-plane business flourished. Ryan moved to a safer field at the north end of San Diego Bay, known as Dutch Flats. Increasing numbers of tourists went on sightseeing trips, providing the impetus for expanded flying and manufacturing activities, and Ryan also developed a flight instruction clientele. From the beginning, he maintained standards equivalent to Air Corps training. The payoff occurred years later, when the Ryan School of Aeronautics became one of the handful of civilian schools chosen to augment the Air Corps' own primary instruction program.

Claude Ryan, the boy who saw the sky as his natural element, now was started on the air trail that was to lead him through many pioneering phases—the first regularly scheduled year-round passenger airline in America; the first monoplane in quantity production; the first plane to fly from New York to Paris non-stop; the first jet plane for the U. S. Navy and the first combination jet and piston engine aircraft in the world.

A young man had traveled a long way from that autumn day in 1911 when he saw his first airplane in Parsons, Kansas. He was piloting his own business. There was much "weather" ahead, but he knew where he wanted to go, and he was plotting and flying "on course."



SUPER 260 NAVION — **Typical of the use to which business executives put the rugged Ryan Navion is the varied activity of Moss Patteron, of Oklahoma City. He operates a 6,000-acre cattle ranch, the Lazy S, near Ardmore, Okla., and Mid-Continent Trailways, one of America's major bus lines. Navion helps him keep constant tab on scattered operations.**

PRIVATE FLYING IS GOOD BUSINESS

ALMOST from the beginning of his 30-year career in the aviation industry, T. Claude Ryan was interested in the strictly personal aspect of flying.

"Mass" transportation, such as the "Los Angeles-San Diego Air Line," distinguished the early Ryan activities. But the individual flier—how to accommodate his need, and what sort of plane he wanted—concerned the company founder so greatly that the Ryan name ultimately became synonymous with the best in private flying.

Today, more than 2,000 Navions, highly successful business-executive four-place planes, are operated by private owners—companies as well as individuals—for business and pleasure throughout the world. These sleek, high-performance, all-metal, low wing planes with their clean lines and aerodynamic efficiency are the culmination of a steady development in design and utility.

As far back as 1923, when Ryan moved his flying activities from a cramped strip surrounded by power lines

STANDARD — **As far back as the 1920s, T. Claude Ryan was selling personal planes to business firms. This rebuilt Standard was operated by Byerly Hermanos (Beyerly Brothers), distributors of automobiles and farm implements for Lincoln-Ford-Fordson in wide territory out of Navojoa, Sonora, Mex.**

BROUGHAM — Here was the M-2 Bluebird, first of the Ryan Broughams, which became the most widely used business planes of their day. This was cabin model of the popular M-1 mail plane designed for use on scheduled airlines.

at the waterfront to Dutch Flats, a more comfortable field at the northern end of San Diego Bay, he attracted private flying enthusiasts. Because he offered free tie-down space, the Ryan air field soon became the gathering place in San Diego for private plane owners. Ryan felt that if the field was busy, he too would be busy.

Later, when he converted two-place war-surplus Standard biplanes to five-place enclosed cabin "transports" for his sightseeing business and airline, he received orders from well-to-do individuals to make the same conversion for them. These early Ryan-Standards were the counterpart, in the 1920s, of the business-executive "Navions" a quarter century later.

For several years, an important segment of Ryan's business was buying surplus or used planes, and remodeling them to good operating standards to satisfy the wishes of private owners. He was in effect, part manufacturer, part distributor. The first strictly Ryan creation, the M-1, a spectacularly successful monoplane designed for the air mail service, and its improved versions, the M-2 and Brougham, went to private owners as well as to airlines in the mid-1920s. Ryan also became a distributor of private planes, when he merchandised the Great Lakes biplane all over the west.

While building planes for scheduled airline use and adapting some of them to private use, Ryan felt that this was not a wholly satisfactory arrangement, as far as the individual owner was concerned. What was needed was a plane designed from the outset to meet the private pilot's own particular desires. At the same time, because he was so interested in pilot instruction, Ryan envisioned another use for such a plane—as a trainer.

He boldly tackled this project in the lowest ebb of the depression. Using his own money, and with such key employees as Millard Boyd and Will Vandermeer, (both still with the company), Ryan developed what was to become the country's outstanding low-wing, two-place sport-trainer, the all-metal S-T, which set aerobatic and efficiency marks in various parts of the world.

Launching a new type plane which was a marked advance from biplane designs was a gamble, especially during hard times, and Ryan assumed the entire financial responsibility. He accepted no payment from the stockholders for its development until the S-T became a proved and accepted fixture in aviation. By 1935, the S-Ts were so popular that they were being turned out of the Ryan factory at Lindbergh Field on a production line basis, requiring the first major expansion of the plant.

S-Ts were shipped to several foreign countries, where their fame had spread among sportsmen pilots. In 1936, using a stock model S-T, "Tex" Rankin, the greatest stunt pilot of his day, won the International Aerobatic Championship in St. Louis. The Ryan monoplane defeated a field of specially built American and foreign stunt aircraft.

From the open cockpit S-T, development of the enclosed S-C was an inevitable step forward. Produced late in 1937, the S-C metal cabin plane was the first private owner type which took full advantage of modern metal construction features and full cantilever low-wing streamlined efficiency.

As with the Navion later, the three-place S-C fell victim to international circumstances. It went into regular production late in 1938, and quickly established a reputation as the classiest private plane of its day. But this was the time of Munich, and war clouds were overhead. The S-C had to give way to military plane production, as the Ryan plant went into high gear on manufacture of the P-T series of military primary trainers, developed from the S-T.

After World War II, the Ryan organization returned to one of its first loves in aviation—the private plane field—with acquisition of the design and

(Continued on next page)

TRAINER — Key developers of the S-T included, left to right, John Fornasero, chief pilot, T. Claude Ryan, Millard Boyd, and Will Vandermeer.

S-Ts — A gamble paid off, when this revolutionary advancement over biplanes became most popular sports and training plane type in the country.

S-C — An inevitable advancement over the open cockpit S-T was this slick enclosed cabin three-place plane for private owners. It was produced late in 1937 and was first of its kind to take full advantage of modern metal construction features and full-cantilever low-wing streamlined efficiency. Note similarity to Navion.

RYAN NAVION — Engineers have speculated that, if not for World War II, S-C's natural evolution probably would have resulted in approximate configuration of Navion, originally designed by North American. S-C and Navion were almost identical in easy handling, safety features and other flying characteristics.

manufacturing rights of the Navion from North American Aviation, primarily a military plane producer.

Refinements, based on the company's long knowledge of safety and reliability features wanted by private owners, were immediately incorporated, and the big, rugged, fast, safe and easy-to-fly Navion found rapidly increasing favor.

Engineers were able to speculate that were it not for World War II, the natural evolution of the S-C, through refinement and modification, probably would have resulted in the approximate Navion configuration. The three-place S-C would have gone to four-place; the landing gear would have gone to tricycle; the engine of the S-C would have reverted to the original in-line power plant. As for flying characteristics, the S-C and Navion were almost identifical in easy handling and safety features.

Performance of the Ryan Navion was constantly improved. The first models were powered with 185 and 205 h.p. Continental engines. The latest version, the famed Super 260, has a Lycoming 260 h.p. engine, giving it a cruising speed of 170 miles per hour.

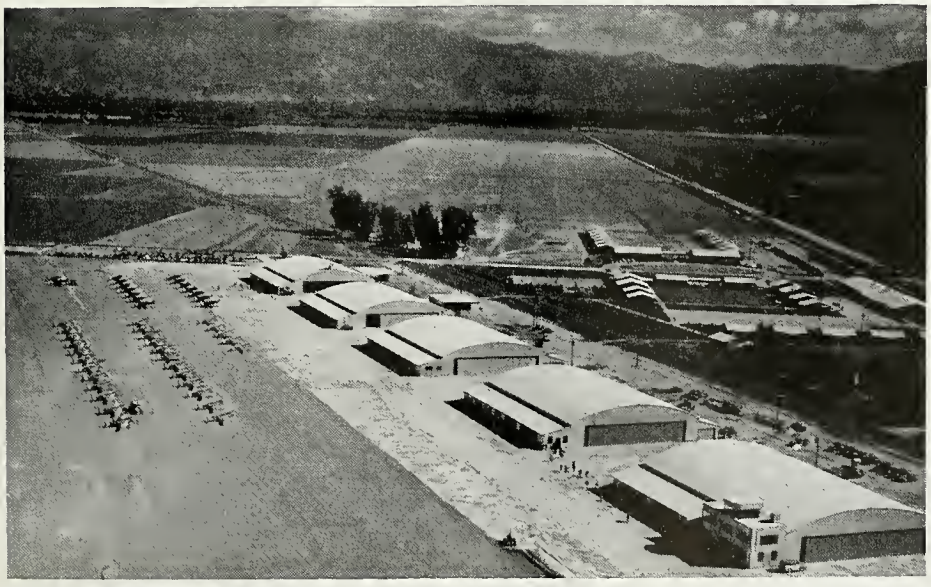
On the proving ground of hard, everyday all-purpose flying by private owners from every business, industry and profession, the Navion has won a solid position. Oil companies, farmers, contractors, manufacturers, doctors—a wide cross-section of progressive America—have proven that the Navion has the utility which gives executive planes an accepted role in our country's transportation system.

A heart-wrenching decision for Claude Ryan to make in 1950, soon after outbreak of the Korean war, was the suspension of the Navion program for the duration of the new emergency. Navion sales were soaring to new heights; a banner year was certain in 1951, but the grim realities of war marred this bright prospect. It became evident that a "guns and butter" philosophy could not be maintained at Ryan. Military requirements were paramount, and every inch of factory space had to be utilized for the production of airframe and engine components.

In this perilous time, the private plane still looms large in Ryan plans. When peace is restored, Ryan planes again will be blazing new frontiers in the utility airplane field.

1939—SAN DIEGO— A familiar sight at the three Ryan School of Aeronautics primary training bases for the Air Force was this lineup of Ryan-built PT type trainer planes which students are ready to take up for day's scheduled flying. Scene above is at the "parent" school of Ryan organization, located at Lindbergh Field, San Diego, California.

FLEDGLING WINGS



1940 — HEMET — When the Ryan School of Aeronautics was selected as one of the first private schools to train flying cadets, its original facilities could not handle the tremendous demands. Expansion was imperative, and another school in California was built in record time on broad expanse of land at Hemet.

THERE was no inkling, back in the 1920's, when T. Claude Ryan began instructing fliers, that he was helping set the stage for the greatest military flight training program ever conducted by a network of civilian schools.

When the nation awoke, in 1939, to the need of air power, the established facilities of the Air Corps were inadequate to handle the swelling number of cadets. General "Hap" Arnold, who was instrumental in helping launch Ryan on his career in 1922 (see Page 47), saw in the nation's private flying schools a ready-made nucleus of expanded flight training.

By 1939, the Ryan School of Aeronautics was the oldest aviation school in the United States under its original management. On the basis of its experience and its operating efficiency, it was one of the original nine commercial schools chosen by the Air Corps to conduct primary training of flying cadets.

(Continued on next page)

1942—TUCSON— When West Coast was declared combat zone, Ryan's San Diego training operations were transferred to a new location in Arizona, 16 miles from Tucson. This base was built at top speed during hottest summer in desert's history. Within a year, flying time had reached 19,000 hours monthly.

The caliber of Ryan instructors and instruction methods was clearly demonstrated when the first group of Ryan civilian instructors went through the Army's standardization course at Randolph Field prior to the start of the contract military pilot training program. Of 15 Ryan instructors enrolled, 13 met Army standards, and of these, 8 were themselves graduates of Ryan commercial pilot training courses. No other school came anywhere near such a high percentage of qualification.

From San Diego headquarters, the Ryan school branched out to Hemet, California, and Tucson, Arizona. In five and one-half years, from July, 1939, to December, 1944, more than 14,000 pilots were trained at these three schools. More than 1,200 cadets were enrolled at one time during peak periods at the Hemet and Tucson schools. There were over 300 flight instructors, an equal maintenance staff, and more than 300 planes in daily use.

Using Ryan PT-16 and PT-20 military training planes manufactured by the parent Ryan Aeronautical Company, the Ryan School at San Diego was the first training organization in the United States to give initial flight instruction of military pilots in low-wing monoplanes. Later, Ryan PT-21s and PT-22s were used. The Ryan School had also pioneered commercial training in low-wing monoplanes in its commercial school several years previously with Ryan S-Ts.

T. Claude Ryan, who received the Presidential Certificate of Merit in December, 1948, in recognition of his organization's wartime contribution in the training of military pilots, had been teaching others to fly since 1922, when he went into business in San Diego.

He aimed his standards high—on the level of the Army Air Corps, where he had received his own training. The old Ryan Flying School at Dutch Flats attained a reputation jealously guarded through the years. By 1929 it was so well considered in official circles that it became one of the first commercial schools to receive the Department of Commerce's highest ratings, the Approved Transport Flying and Ground School Certificates.

Ryan was one of America's first fliers to see the value of training in a private school on a well-organized, systematic basis. His own experiences led him to this conclusion, hastened by the contrast between the Air Corps' rigid methods and the rather carefree, disorganized attitude of the school in Southern California where he himself sought his first flight training in 1917.

Ryan, whose original organization had built the "Spirit of St. Louis," was one of the first to occupy Lindbergh Field, the new shoreline airport reclaimed from the bay by dredging soon after the Lone Eagle's transatlantic flight. He moved his flying school to the new field in the early 1930s and built the administration building and hangars which were later to become the foundation of the Ryan School of Aeronautics, formally organized by incorporation in 1931, and later a wholly owned subsidiary of the Ryan Aeronautical Company.

A driving force behind the school was Earl D. Prudden, who joined the Ryan School as sales director in 1928. He rose to vice president (the post he still holds in the Ryan Aeronautical

1929 — T. Claude Ryan's pioneer flying school in San Diego was one of nation's first to win top rating from Department of Commerce in 1929. Shown with Ryan are Sanis E. "Bob" Robbins, chief flight instructor, at left; and Earl D. Prudden, right, then, as now, vice president. Robbins later became a distinguished Alaskan bush pilot.

Company today), and as v.p. and general manager directed the school's activities during its commercial and military zenith.

Comprehensive instruction was provided, and approximately 250 students each year came to San Diego from all over the world. Commercial training was provided pilots who wanted to make a career of flying, while sportsmen pilots and business men qualified for private pilots' licenses.

Complete ground school technical instruction also was given to train airplane and engine mechanics, aeronautical designers, engineers and other aviation technicians, many of whom graduated from the Ryan school into the Ryan factory. A record enrollment was in training that fateful December day in 1941, when all commercial training was ordered stopped in coastal areas by outbreak of war.

Ryan's brightest training achievement in 30 years of aviation history was, of course, accomplished during the war years. The Hemet and Tucson fields were built in record time on barren sites. At the Arizona location, 16 miles from Tucson, construction proceeded at top speed through the hottest summer in the history of the desert. Within a year, student flying time had reached a peak of 19,000 hours per month. At Hemet, the training efficiency was so great that what is believed an all-time record was set—98.5 percent of the cadets enrolled were qualified to graduate in the largest class ever to go through that school.

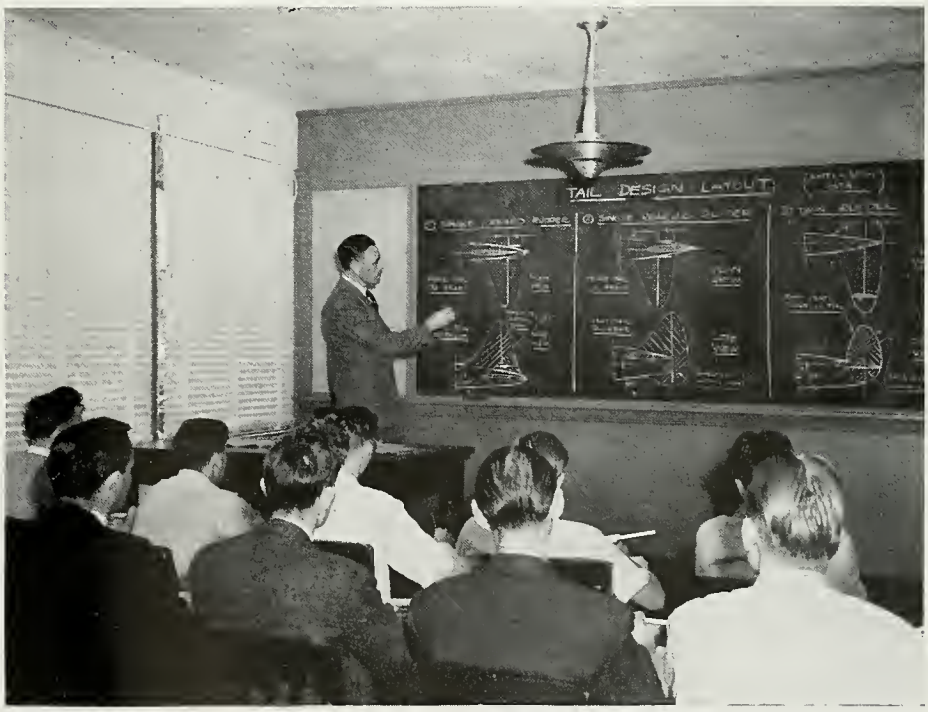
Ryan had further reason for pride, when the names of the pilots who participated in General Doolittle's raid on Tokyo were revealed. Four of them had been trained in Ryan schools.

The first class of 35 aviation cadets had begun flight training at San Diego July 1, 1939, and training continued there on an increased basis until August, 1942, when the coastal area was declared a combat zone and operations transferred to the Tucson school. Training at the Ryan School of Aeronautics of Arizona continued until September 5, 1944.

Construction of the Hemet school began in July, 1940, and was rushed to completion in record time. Within three weeks the hangars were in use, barracks and dining hall were ready; and in 37 days all facilities required to handle 600 flying cadets were completed. Hemet was the last of the three Ryan schools to terminate training, the last class being graduated in December, 1944.

1931 — The Ryan School of Aeronautics was formally organized by incorporation in 1931. The handsome hangar and administration building, built in the early 1930s at Lindbergh Field, were for many years outstanding landmarks in San Diego.

1937 — Instructar briefs student before training hop at the Ryan School of Aeronautics in days when company was establishing the reputation that gained its important role in wartime military pilot instruction.



1942 — Typical of the highly specialized technical training provided by the Ryan School of Aeronautics was this class in aeronautical engineering. Graduates often took good positions in the Ryan factory on completion of courses in the school.

30th Anniversary

THE PIONEERING TEN

2. Earl D. Prudden

3 & 4. H. J. van der Linde and Walter O. Locke

5. Melvin Thompson

A company's continuity is preserved only by the faithful service of its employees. The Ryan company's "family tree," firmly rooted in T. Claude Ryan himself, has been kept strong by the devoted efforts of thousands of men and women whose talents and energies have produced some of America's best-known aeronautical products. Pacing this great legion of workers are the "senior ten" pictured on this page, the ten men with the longest period of service over the last three decades. They are typical of the conscientious Ryan employees who provide the sturdy chain linking the productive past, the busy present and the promising future.

1. When T. Claude Ryan went into business 30 years ago, his workshop was a piano crate. Today he heads a steadily growing concern of 4,000 employees.

2. Second oldest in point of service, Earl D. Prudden joined Ryan 24 years ago. He sparkplugged training activities, now is company's vice president.

3. John van der Linde, production manager, has 23 years' total service, first flew for Ryan in 1923, returned to direct assembly of famed Ryan planes.

4. Walter O. Locke, a 21-year veteran of Ryan service, worked on "Spirit of St. Louis," held various executive posts, now is assistant to president.

5. Melvin E. Thompson, supervisor of change control, 18 years ago was dissuaded by Ryan from quitting to become fireman. Service totals 20 years.

6. Will Vandermeer, now mechanical design chief, helped plan S-T, forerunner of noted series of Ryan planes. He has been with organization 19 years.

7. M. W. "Buck" Kelley, senior night production superintendent, advanced through ranks from assembly line mechanic during 18 years' service with Ryan.

8. Walter K. Balch, whose 17 years at Ryan included direction of technical training and maintenance at school, is general supervisor of Navion service.

9. Crackerjack mechanic in Ryan's service department is Carl F. Nesbitt, 17-year veteran, who has made countless test flights after overhaul and repair.

10. Sam C. Breder, director of customer service, has been Ryan's top salesman for 17 years. He has one of the broadest acquaintanceships in aviation.

6. Will Vandermeer

7. M. W. Kelley

10. Sam C. Breder

1 & 9. T. Claude Ryan and Carl Nesbitt

8. Walter K. Balch

THE AMERICA WE LOST

by DR. MARIO A. PEI

The following editorial by Dr. Mario A. Pei, an Associate Professor at Columbia University, is particularly appropriate for this 30th Anniversary Issue. Dr. Pei, who came to the "freedom-laden air" of America from his native Italy in 1908, writes feelingly of the kind of "boundless opportunity" which made possible the founding and growth of enterprises like the Ryan organization. By contrast he is now deeply concerned with the "vanishing of the American spirit of freedom and opportunity and its replacement by a breathless search for 'security'."

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WHEN I first came to America, forty-four years ago, I learned a new meaning of the word "Liberty"—freedom from government.

I did not learn a new meaning for "democracy." The European country from which I came, Italy, was at that time as "democratic" as America. It was a constitutional monarchy, with a parliament, free and frequent elections, lots of political parties and plenty of freedom of religion, speech, press and assembly.

But my native country was government-ridden. A vast bureaucracy held it in its countless tentacles. Regardless of the party or coalition of parties that might be in power at the moment, the government was everywhere. Wherever one looked, one saw signs of the ever-present government—in the uniforms of numberless royal, rural and municipal policemen, soldiers, officers, gold-braided functionaries of all sorts. You could not take a step without government intervention.

Many industries and businesses were government-owned and government-run—railroads, telegraphs, salt and tobacco among them. No agreement, however trivial, was legal unless written on government-stamped paper. If you stepped out of the city into the country and came back with a ham, a loaf of bread or a bottle of wine, you had to stop at the internal-revenue barriers and pay duty to the government, and so did the farmers who brought in the city's food supply every morning. No business could be started or run without the official sanction of a hundred bureaucrats.

Young people did not dream of going into business for themselves; they dreamed of a modest but safe government job, where they would have tenure, security and a pitiful pension at the end of their plodding careers. There was grinding taxation to support the many government functions and the innumerable public servants. Everybody hated the government—not just the party in power, but the government itself. They had even coined a phrase, "It's raining—thief of a government!" as though even the evils of nature were the government's fault. Yet, I repeat, the country was democratically run, with all the trappings of a many-party system and all the freedoms of which we in America boast today.

America in those days made you open your lungs wide and inhale great gulps of freedom-laden air, for here was one additional freedom—freedom from government.

The Government was conspicuous by its very absence. There were no men in uniform, save occasional cops and firemen, no visible bureaucrats, no stifling restrictions, no Government monopolies. It was wonderful to get used to the American system: To learn that a contract was valid if written on the side of a house; that you could move not only from the city to the country but from state to state and never be asked what your business was or whether you had anything to declare; that you could open and conduct your own business, provided it was a legitimate one, without Government interference; that you could go from one end of the year to the other and never have contact with the national Government, save for the cheery postman who delivered your mail with a speed and efficiency unknown today; that there were no national taxes, save hidden excises and import duties that you did not even know you paid.

In that horse-and-buggy America, if you made an honest dollar, you could pocket it or spend it without having to figure what portion of it you "owed" the Government or what possible deductions you could allege against that Government's claims. You did not have to keep books and records of every bit of income and expenditure or run the risk of being called a liar and a cheat by someone in authority.

Above all, the national ideal was not the obscure security of a Government job, but the boundless opportunity that all Americans seemed to consider their birthright. Those same Americans loved their Government then. It was there to help, protect and defend them, not to restrict, befuddle and harass them. At the same time, *they did not look to the Government for a livelihood or for special privileges and handouts. They were independent men in the full sense of the word.*

Foreign-born citizens have been watching with alarm the gradual Europeanization of America over the past twenty years. *They have seen the growth of the familiar European-style Government octopus, along with the vanishing of the American spirit of freedom and opportunity and its replacement by a breathless search for "security"* that is doomed to defeat in advance in a world where nothing, not even life itself, is secure.

Far more than the native-born, they are in a position to make comparisons. They see that America is fast becoming a nineteenth-century-model European country. They are asked to believe that this is progress. But they know from bitter experience that it just isn't so.

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RYAN

AIRCRAFT AND AERONAUTICAL PRODUCTS

30 years Leadership in Aircraft and Components Design and Production

RYAN FUEL TANKS FOR B-47

L-17 NAVIONS IN KOREA

Ryan activities today blanket the field of aircraft and aeronautical product development and production. From the manufacture of airframe components and high speed pilotless jet planes...to electronic research and development...to executive-liaison airplanes and jet propulsion research, Ryan is helping to strengthen America's air-arm.

THESE GIANT WING TANKS for Boeing's B-47B Stratojet—the largest ever put into production—are an example of Ryan leadership. Each of these huge tanks, comparable in size to the fuselage of the Navion, requires over 30,000 electric spot welds and other advanced production techniques developed by Ryan.

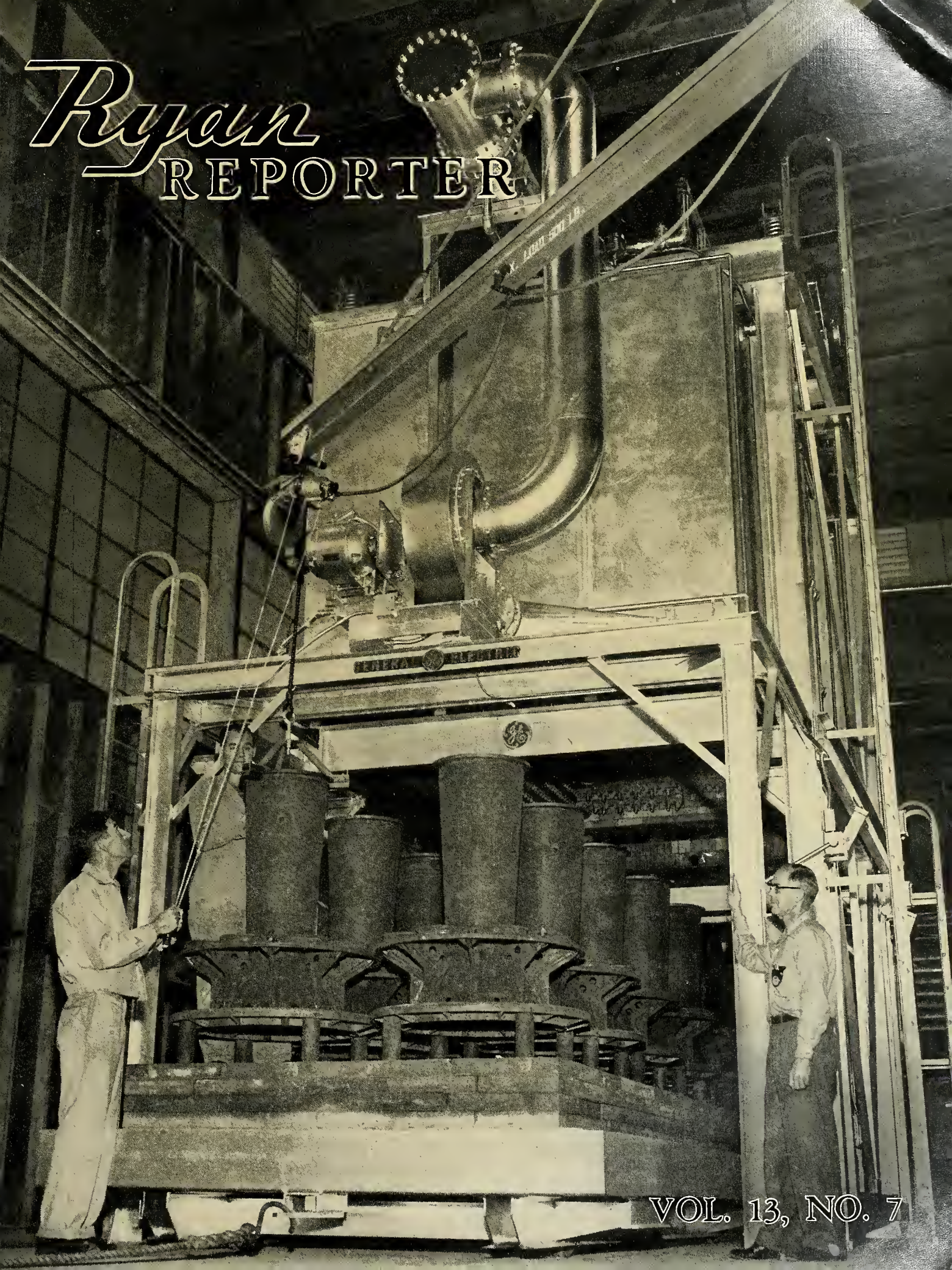
RYAN L-17 MILITARY LIAISON NAVIONS have seen extensive combat service in Korea. They have received high praise for their excellent flying characteristics, efficiency in operating from short, rough fields, and proved ability in light transport missions and aerial reconnaissance.

AIRPLANE DIVISION

RYAN AERONAUTICAL COMPANY

LINDBERGH FIELD • SAN DIEGO, CALIFORNIA

Ryan REPORTER



VOL. 13, NO. 7

HOW SOCIALISTIC ARE YOU?

You've heard about socialism from all sides, now here's your chance to determine how you feel about it

Socialism, because it appeals to our natural charitable instincts, finds some degree of acceptance in most of us.

And because unlike violent communism, socialism moves forward at an easy pace, it can overtake a nation without the people being conscious of what is happening.

Socialism is composed of very definite ingredients which, like separate pieces of a jigsaw puzzle, have no meaning until assembled into the grand pattern.

Until we know what these ingredients are and whether we like them or not, we cannot tell how socialistic we are.

The material that follows is an effort to give you a simple yardstick with which to measure your own personal attitude toward socialism.

first...

Do you accept socialism's major premise that the world can be perfect — that there is a form of government that can eliminate the personal tragedies and injustices that have plagued the human race since the dawn of history?

If you accept this, you are then able to keep your eyes glued upon this shining goal and ignore the tragedies and injustices that must be perpetrated in order to reach that imagined goal.

In other words, if you concentrate hard enough on the end, you can justify, in your own mind, the means that must be employed to reach that end.

The most classic example of this self-hypnotism was the socialist attitude toward the deliberate starvation of millions of Ukranian peasants who refused to "cooperate"; their death was a mere incident on the road to heaven-on-earth.

second . . .

Do you approve of one of socialism's major policies— which we already have in America — the progressive personal income tax?

Does it give you a certain satisfaction to know that the man who earns ten times as much as you do has to pay thirty times as much tax?

This tax policy was taken right out of the socialistic platform and is based on the socialist principle: "From each according to his ability, to each according to his need."

If you go along with this idea, you have taken one big step toward socialism.

third . . .

Do you approve of high inheritance taxes (now in effect in the United States) which make it impossible for people to pass on any worthwhile degree of economic security to their children or family?

Just as the progressive tax prevents the formation of any important new group of wealthy people, the inheritance tax insures that most of the present wealth will pass into the hands of government upon the death of its present holders.

It is very important to the promotion of socialism that the accumulation and holding of wealth be made impossible; so if you approve of the tax laws which accomplish that end, you are giving aid and comfort to socialism.

fourth . . .

Do you approve of the present law which took gold from the people and gave unlimited spending power to the Federal Government?

This is the secret weapon of socialism because it gives Government control over the money supply and (through its inflation) control over the value of the people's earnings and savings.

In the words of Karl Marx, it enables government to "debauch the currency."

This control over the money has another value to socialism: it gives the Government a bottomless purse from which it can subsidize special groups and, in effect, buy the people's votes.

If you can say, "That's all right with me," you have gone a long way toward becoming a socialist.

fifth . . .

Do you believe that the relationship between "labor and capital" is essentially hostile?

Does the group of workers known as "management" (who plan the production and find the customers) inevitably seek to depress and abuse the group of workers known as "employees"?

Do you consider it impossible that they could ever be partners instead of adversaries?

If your answer is "yes," then you must go along with the idea of using the power of government to protect "labor" from "capital."

sixth . . .

Do you believe that profit is a drag on the economic progress of the people?

Do you believe that these payments for the use of people's savings (which have become tools of production) represent a cost that could and should be eliminated from the economy?

Do you think that the desire for profit inevitably results in monopoly, unfair practices, and exploitation of the customers?

If your answer is "yes," the logical step is for you to support the policy of government ownership and management of the tools.

seventh . . .

Do you believe that government can give anything to the people without first taking it away from the people?

This deception is socialism's neatest sleight-of-hand trick.

The idea of "Federal funds" and "Federal aid" implies that the government can be a source of goods and revenue instead of just a redistribution agency.

Yet millions of intelligent people have been hoodwinked by the "Federal horn of plenty."

sum them up . . .

The seven "test questions" cover most of the mental processes that lead people into supporting socialism.

By grading yourself, you can find how far (if at all) you have been led down the road to Marxism.

But if your score is bad, don't be surprised, because every one of these ideas when considered separately has definite appeal.

Q-2 WITH I.Q.

Endowed with faster than human "reflexes," Ryan's pilotless plane is the newest target drone

SHARPLY swept wings and tail surfaces appear to be the outstanding design features of the Ryan Q-2 pilotless target plane on the basis of an artist's conception of the high-speed jet-propelled drone.

The silhouette drawings, released last month with Department of Defense approval in the 30th Anniversary Issue of Ryan's house magazine, are obviously intended to reveal a minimum of design, dimensional and performance information.

"High above the desert sands of New Mexico," said the Ryan Reporter article, in the only reference to the Q-2's current flight program, "a small pilotless jet airplane streaks across the sky at near sonic speed, guided only by the hand of a grounded 'pilot' at a remote control panel.

"It is Ryan's new target drone, designed for anti-aircraft and aerial gunnery training and for use in combat plane interception problems by Army, Navy and Air Force units.

"Little has been written or can now be revealed of its design details beyond the bare description that it is less than half the size of modern American jet fighters, but with comparable performance."

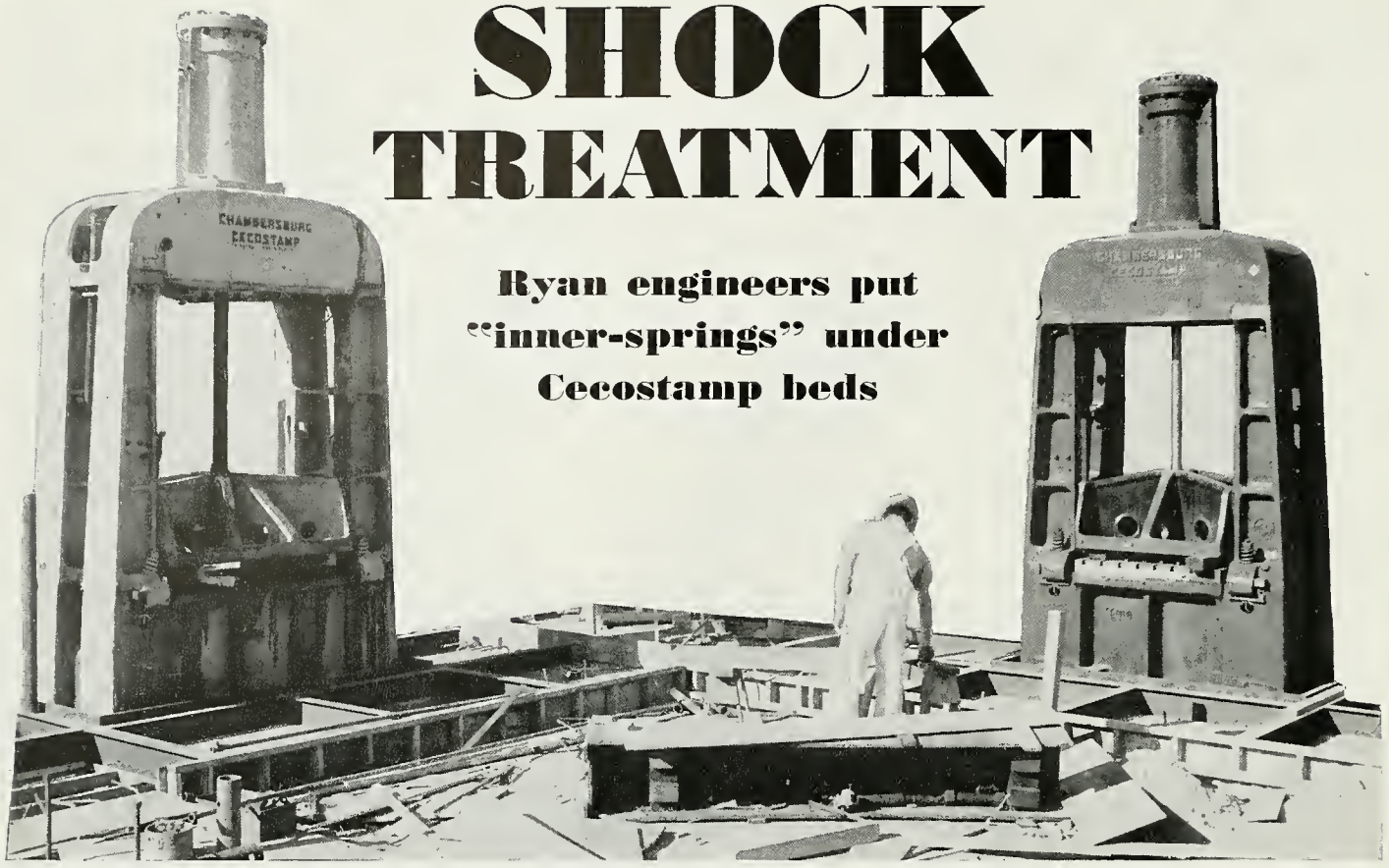
The original development contract was awarded the Ryan Aeronautical Company as a result of a design competition with 14 other aircraft manufacturers. The Q-2 is a joint project of the Air Force, Army and Navy with the Air Force having technical responsibility for its development.

This is Ryan's second announced project in the field of pilotless aircraft. Its experimental, rocket-powered Ryan XAAM-A-1 "Firebird" was the first air-to-air guided missile to be disclosed by the Air Force. Work is continuing under Air Force contract on some phases of the "Firebird" development program.

No information has been released on the quantity of Q-2s manufactured or in operation, or the present status of the program, though Ryan announced in its first reference to the target plane that the contract was for a "service test" quantity. A year later the company disclosed a further contract to "continue the development and fabrication of an additional quantity of the jet-powered aerial targets."

SHOCK TREATMENT

Ryan engineers put "inner-springs" under Cecostamp beds



With a 106,000 pound punch, Ryan's new Cecostamps would become "pile drivers" without their ingenious mountings of coiled springs.

FLOATING islands of concrete form the foundations for two mighty Cecostamps which are the newest additions to Ryan Aeronautical Company's hammer forming department. Consisting of huge concrete blocks, weighing as much as 138,000 pounds, these foundations are cushioned upon sets of Korfund coiled steel springs which permit them to "roll with the punch" of the Cecostamps' hammers.

Designed by Herbert Sadd of the Ryan plant engineering department, the floating foundations eliminate the destructive vibration created by the operation of the hammers. Employees are benefited by insulation from shock and vibration which cause fatigue and discomfort. The life of equipment and buildings, surrounding the area, will be materially extended. The Cecostamps, themselves, will last longer and require less maintenance because of the absence of vibration.

Cecostamps are powerful impact machines which are used at Ryan to form metal contours. Unlike drophammers, they are actuated both by air pressure and gravity. A large air cylinder and piston drives the 7000-pound ram and heavy lead punch down against the work with tremendous impact. By merely raising or lowering a lever the operator can oscillate the ponderous ram at high speed and without fatigue.

Close-up of Korfund spring set reveals nine matched steel coils, each capable of absorbing 2800 lbs., per inch of deflection. Steel springs are best elastic material because they can be designed to provide exact performance required.

With each blow of their hammers, the new Cecostamps exert as much as 106,000 pounds of force to form Ryan parts. In the past, it was considered good practice to mount this type of machine on a wooden wearing surface and bolt it tightly to a fixed concrete foundation. This method permitted the transmission of the damaging vibration, almost undiminished, to all surrounding areas and subjected the machine to heavy shock.

As these effects became evident, a more efficient system of installing such equipment became necessary. The Korfund Company, makers of the steel spring vibro-isolators used in the Ryan

installations, have pioneered in this development.

At first glance, it might be thought that the best solution to the problem would be to mount the offending machine upon an elastic material. This is not the case. This method takes away from the efficiency of the machine by reducing the force of impact at the moment of impact. A conception of this phenomenon could be obtained if you tried to pound a nail into a board supported upon sponge rubber. It is necessary to interpose a time lag between the impact and the dispersion of the vibration so that the full force of impact is maintained. This can be accomplished by placing an inertia mass between the anvil of the machine and the elastic insulation.

Ryan plant engineers directed that the Cecostamps be mounted upon huge reinforced concrete blocks which "float" in pits approximately 10 feet deep, 16 feet wide and 22 feet long. These masses momentarily absorb the force of the hammer blows. The huge blocks are suspended upon two rows of Korfund coiled, steel springs placed along the bottom edges of the pits. Made of cold-rolled crucible steel, each of these vibro-insulators is capable of absorbing a force of 2800 pounds per inch of deflection. More than 100 of them are located in the larger installion to absorb the vibration from the inertia block.

A good analogy of this arrangement would be the circus act in which a blacksmith's anvil is placed upon the chest of a strong man and two performers pound on it with heavy sledge hammers. The anvil absorbs the impact, transmitting it gradually to the strong man's chest. The larger the mass of the anvil, the less the effect of the blows is felt by the strong man.

However, in designing a vibration absorbing foundation for a large machine, such as the Ryan Cecostamps, careful consideration of the laws of impact and vibration must be made. The weight of the inertia block struck by the hammer must be great enough at the moment of impact to provide sufficient inertia so that elastic deformation does not occur. Also, the block must come to rest before the next blow is struck. The mass and period of vibration of the block must be controlled so that the amplitude of movement is within acceptable limits and acceleration must not exceed that due to the force of gravity.

Starting with the impact loads and vibration frequencies of the Cecostamps,

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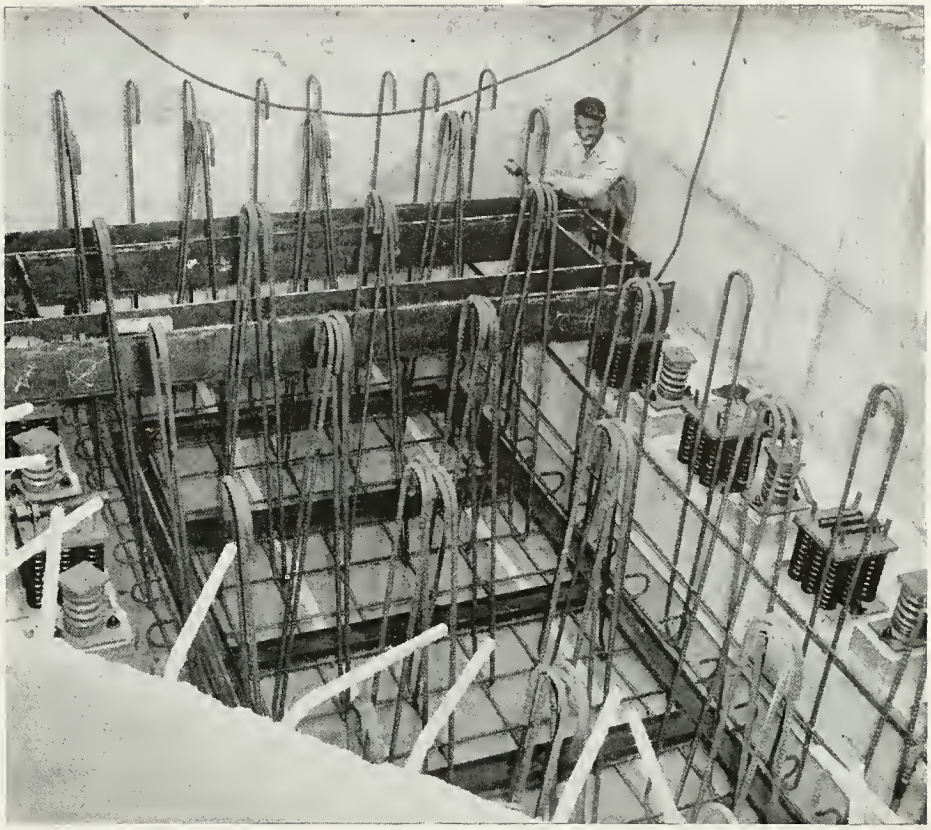
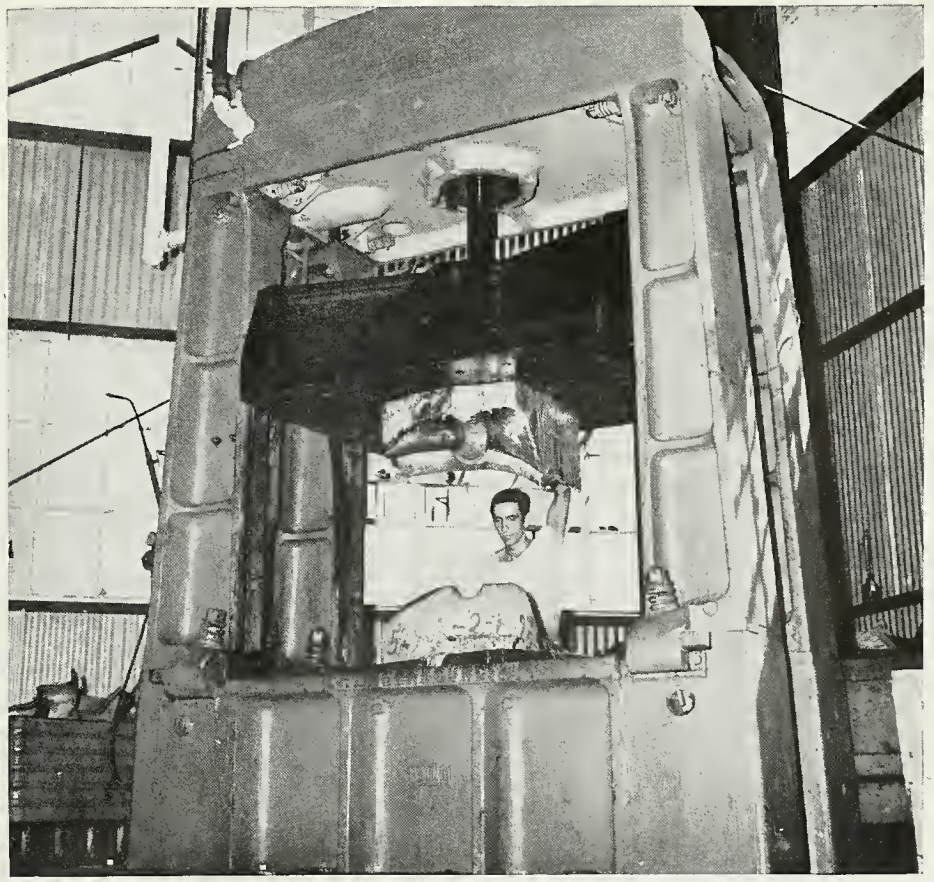


A network of reinforcing steel and supporting beams is arranged in pits prior to the pouring of the concrete inertia blocks. Beams are suspended on 12 sets of springs.



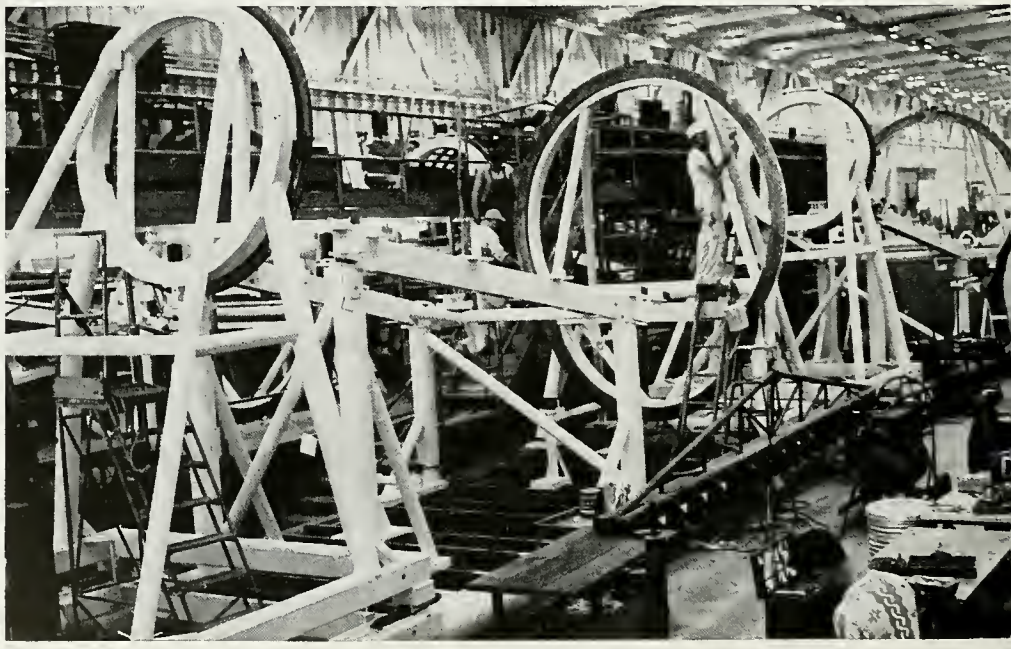
Faster than a skilled carpenter can pound a nail, Clifford Crist can wield the 7,000 pound hammer of this Cecostamp to form stainless steel exhaust systems for aircraft.

Ryan builds aft fuselage sections and refueling pods for KC-97 aerial tankers, some of which are shown at March Air Force Base.

FOUR WAY

Boeing KC-97 is equally adept as cargo carrier, troop transport, hospital plane or "flying service station"

Production of aft fuselage sections has spurted at Ryan with addition of these two huge jigs, effecting 90 percent more output with only 50 percent boost in facilities.



DUTY

AMERICA'S most versatile cargo and transport type plane, the Boeing KC-97F Stratofreighter, is being delivered in increasing quantities to the Air Force—a fact of prime importance to Ryan Aeronautical Company, which has a vital interest in both "ends" of this aerial giant.

At March Air Force Base, Riverside, Calif., where two new squadrons of Stratofreighters are in operation, Master Sgt. Vernon Dayhoff, line chief for the 22nd Air Refueling Squadron, reports that his crews agree these are "wonderful" ships to work on, from the Ryan-built aft fuselage section and refueling pod to the Ryan exhaust systems for the Pratt & Whitney Wasp Major engines.

Ryan's two major divisions are stepping up production of these "fore and aft" components. The Airplane Division is producing great quantities not only of aft fuselages and pods, but of cargo doors and floor beams. The Metal Products division is manufacturing exhaust systems for the "Dash 59," the powerful new Pratt & Whitney R-4360-59 3500 h.p. Wasp Major four-bank 28-cylinder engines. Incidentally, a unique departure from past practice in the aircraft industry is the fact that Pratt & Whitney now is furnishing the Ryan exhaust systems as part of the engine "package." Heretofore, the exhaust systems were sent directly to the airframe manufacturer.

To meet the rapidly accelerating production demands of Boeing, Ryan has completed one of its biggest tooling projects in years. Two giant jigs have been added to the four on the production line for the largest component of the aft fuselage section. This 50 percent increase in jig capacity will be accompanied by a 90 percent boost in output by next summer through improved assembly methods, and other means. Additional jigs for smaller portions of the aft fuselage also have been constructed in a tooling program that began early this year.

The KC-97F is the tenth model in the famous Boeing C-97 family, and its versatility comes from its ability to play many roles in the Air Force—as a cargo and troop transport, as a hospital plane, or as a "flying service station."

In the 350-mile-an-hour speed range, the KC-97F can be rapidly converted from its basic freighter configuration to that of an aerial tanker designed for mid-air refueling of fighters and bombers to increase their range. In that capacity, the Stratofreighter has assumed a major place in the Strategic Air Command's scheme to deliver the most potent bomb loads the farthest.

This transformation is effected through a Boeing-designed "package," much of which is produced by Ryan. The "package" consists of a Flying Boom, which utilizes a telescoping metal pipe to transfer fuel from the tanker to the receiver plane; the Flying Boom's controls, and the operator's station in the Ryan-made pod, which is an integral unit of the aft fuselage section.

Assembled as a single unit, the Flying Boom, its controls and the pod are attached beneath the Stratofreighter in the space normally occupied by the rear cargo doors. (Ryan's aft fuselage section is built complete with refueling pod and cargo doors.)

The conversion, which requires only a few hours in the field, is accomplished by removing the cargo doors. Auxiliary fuel pumps, lines and tanks are then loaded by means of the plane's own electric power hoist, which also lifts and installs the pod. This procedure is followed by making inter-connections of fuel and electrical lines, all permanent fixtures in the basic airplane.

As a transport, the new KC-97F can carry 134 fully-equipped troops. As a hospital plane, it has capacity for 79 litter patients, with medical attendants and supplies. As a cargo carrier, it can

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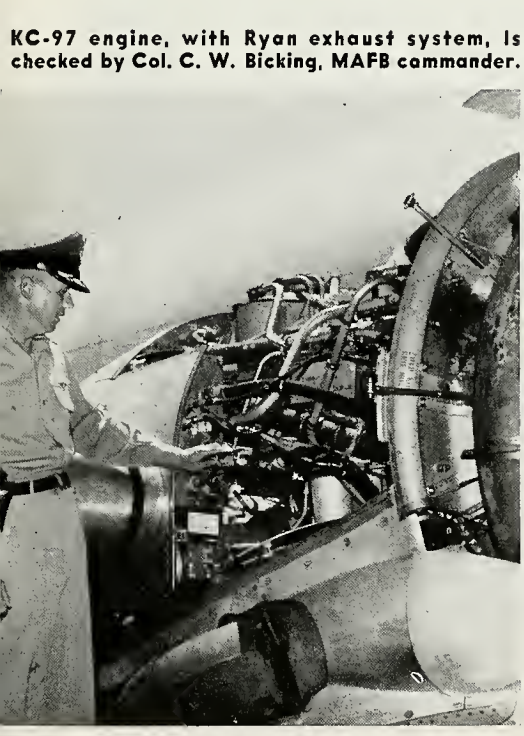
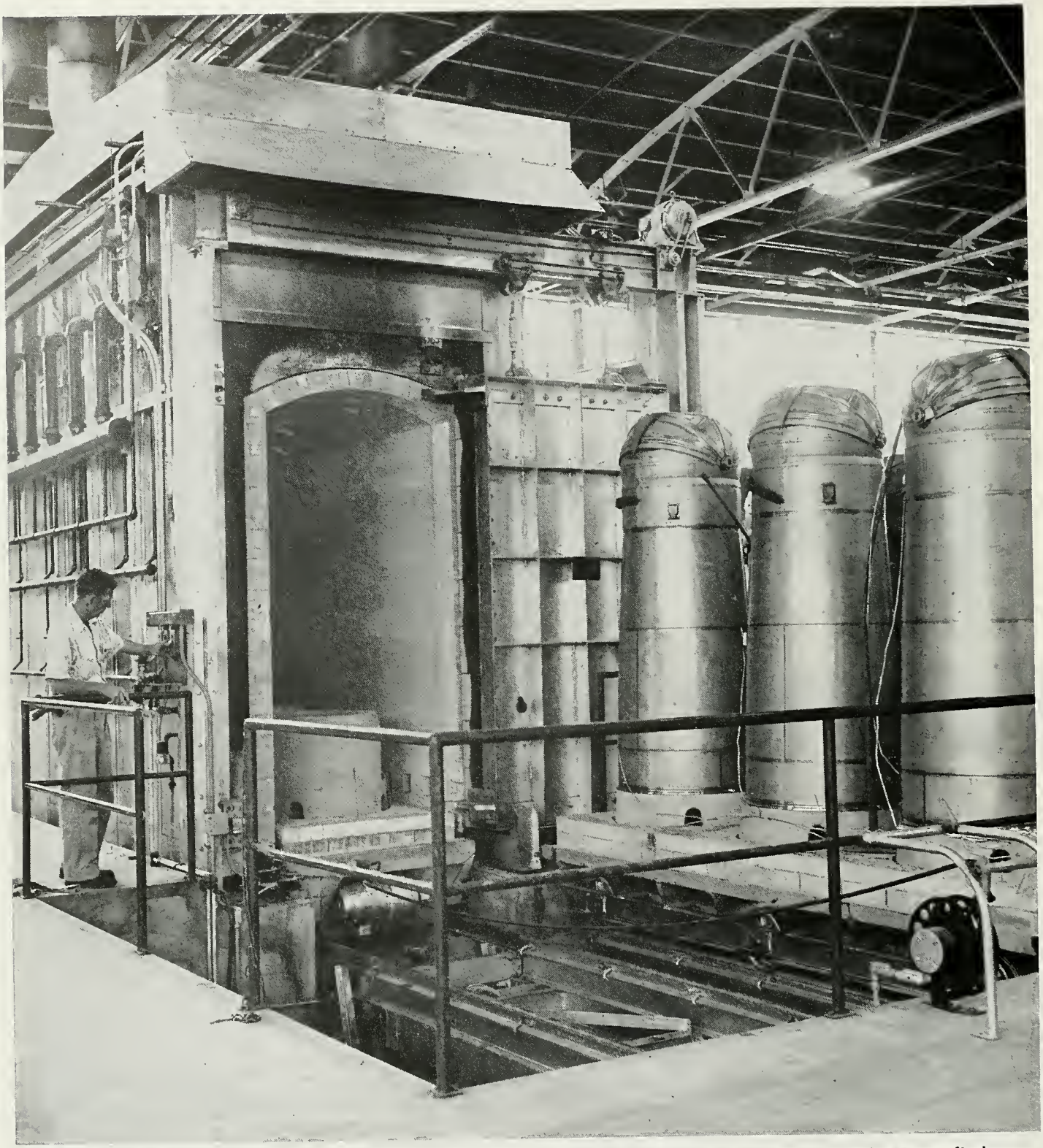
KC-97 engine, with Ryan exhaust system, is checked by Col. C. W. Bicking, MAFB commander.



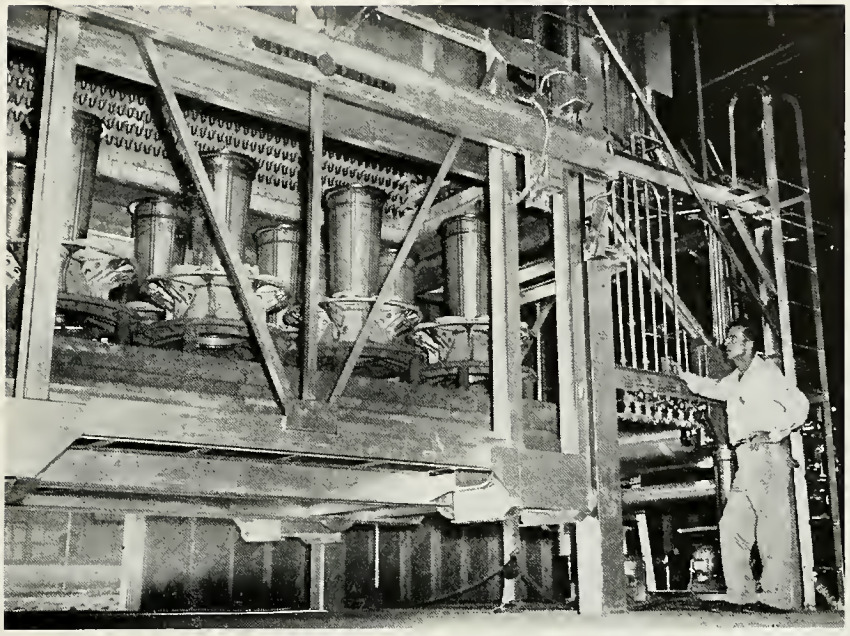
KC-97 is one of America's most versatile planes, serving as transport, flying hospital or cargo carrier, and after rapid conversion, as tanker for mid-air refueling.



Glenn Conrad opens the door of the new Industrial Systems furnace, especially designed to heat treat gleaming Ryan afterburners.

Fiery Furnaces

Metal tensions are relaxed at Ryan with artificial fever



Ryan jet engine frames are hoisted into new G-E electric furnace which has controlled atmosphere, heating and cooling cycles. Glenn Conrad operates.

strains existing in metals while they are free from external loads. They are caused by differential plastic flow which can result from rapid and uneven cooling of hot metal, forming, cold working, machining and other processes which produce working or loading of the metal.

In performing welding, heat is applied to a localized zone. The outer layers of molten metal cool first and solidify. As the material proceeds to thermal equilibrium, further contraction is opposed by the metal which has already hardened. This opposition creates residual stresses.

Similarly, in forming, a differential plastic flow occurs in which the crystals are elongated or otherwise deformed. The deformation takes place in the molecules and atoms as well as in the crystals and tends to pull the atoms out of their characteristic pattern or lattice. Seeking

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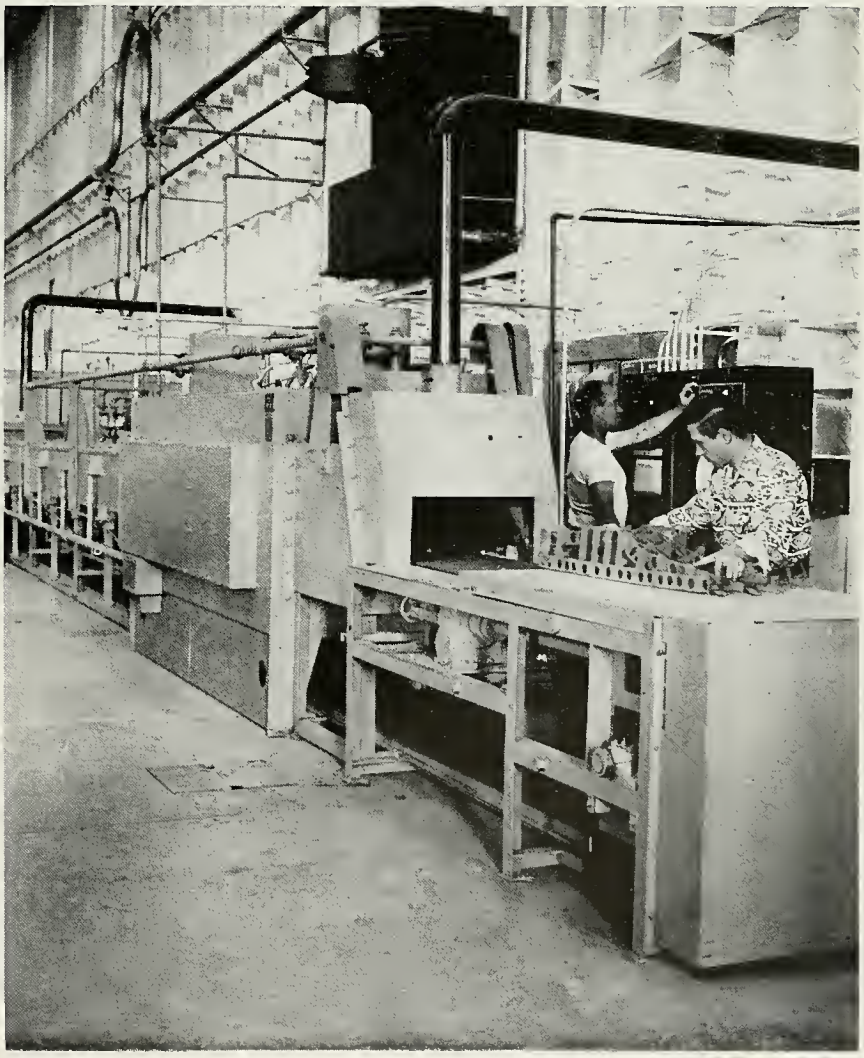
Ryan rocket motors are "relaxed" in this continuous Lindberg furnace. Controls are set by Ray Campbell (right) while Bruce Creager loads endless conveyor belt.



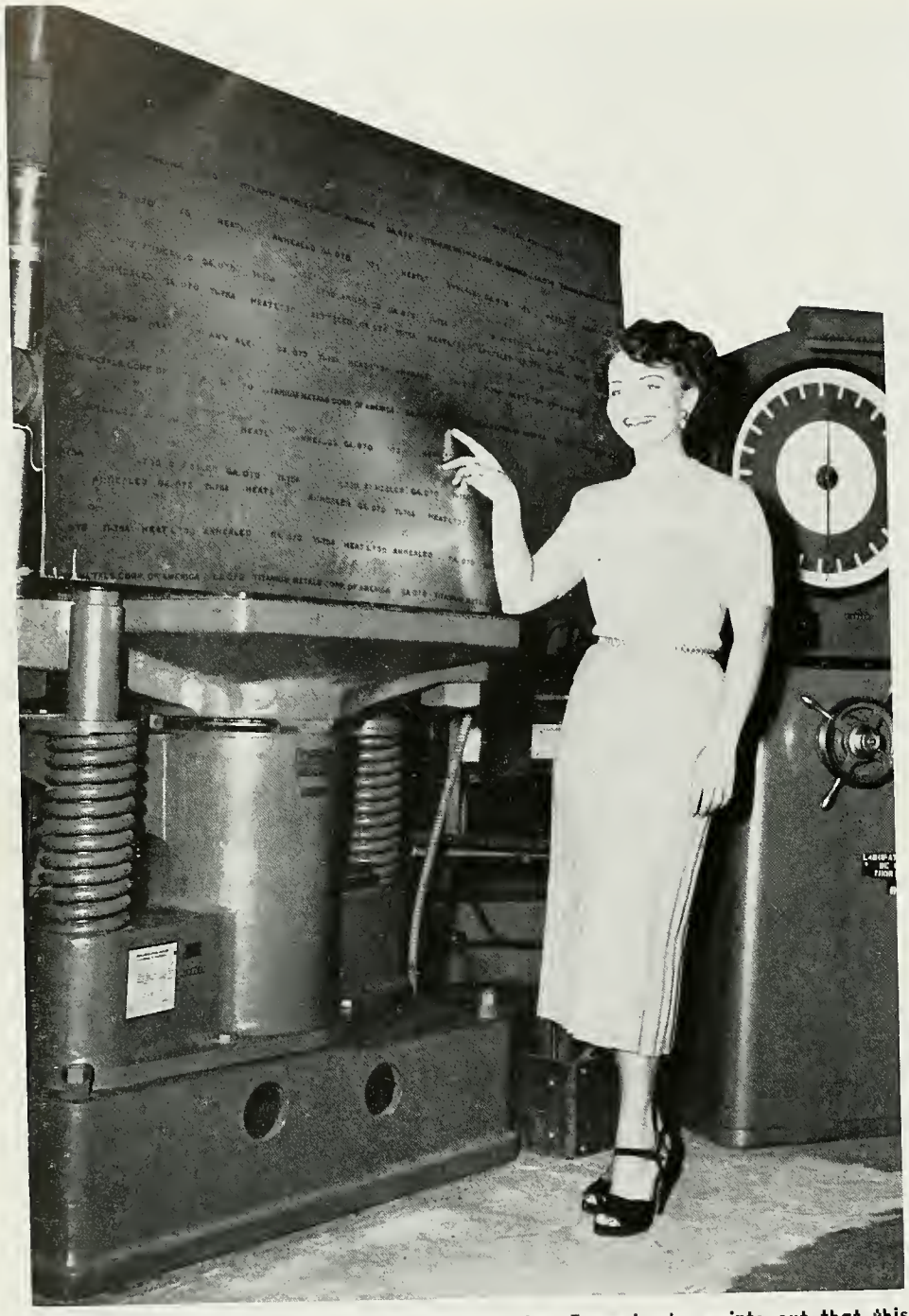
FOUR large, new furnaces, each different in design, have been installed recently at Ryan to "put the heat on" jet engine components. Including a towering second story model with an elevator bottom, and a 52-foot long tunnel type, these unusual furnaces point up the importance of heat treatment in Ryan's production program.

Augmenting the present array of nine heat treating furnaces, the new facilities will be used to stress relieve Ryan afterburners, rocket motors, aft frames and other jet engine components. The installations are the most modern types, especially tailored to meet the exacting tolerances and fine finishes of jet power plants.

RESIDUAL STRESS

In industry, heat treating is used for a wide variety of purposes. At Ryan, it is employed almost exclusively for relieving the residual, "locked up," stresses caused by welding and forming processes. Many manufacturers, including fabricators of stainless steel, have no need for stress relieving their products because they are not subjected to high temperatures and stresses in use. However, Ryan components meet critical temperatures and loads in service and stress relief is, therefore, a "must" in their manufacture. Also, the extremely exacting dimensions to which jet engine parts are designed have intensified the need for closely controlled stress relief.

Residual stresses may be defined as



High cost of titanium alloy is emphasized by Pat Ferrari who points out that this single sheet is worth more than $600. Now valued at more than $20 a pound, titanium's sky-high price tag will be brought down as aircraft industry steps up requirements.

NEW TITANIUM CONTRACTS

Ryan research will put the saddle on industry's most promising Mustang

RYAN Aeronautical Company's venture across a new frontier in aircraft metallurgy — the use of the temperamental metal titanium — has resulted in Air Force and Navy Bureau of Aeronautics contracts for research and development.

The work for the Air Force is to determine the best methods of processing titanium for use in conjunction with exhaust systems, a field in which Ryan has long specialized.

Announcement of the contract award came only a few days after Brig. Gen. Kern Metzger, director of the Aircraft Production Resources Agency, told 150 members of the San Diego chapter, Institute of Aeronautical Sciences:

"In the battle to keep down weight, titanium is our newest alloy. The Navy also looks to titanium as the answer to many problems with salt water spray and salt air corrosion for both aircraft and sea-going vessels.

"By utilizing titanium it is possible to design and produce aircraft to operate at speeds which involve temperatures in excess of those permissible by today's conventional materials."

The Air Force, Metzger said, has drafted a program to stimulate production by private industry, and has set aside $5,000,000 to explore the vital material.

Because of its peculiar characteristics, titanium requires special handling, in the forming, cleaning and welding processes. But the military services are interested in its use because of its great strength-weight ratio and the possibility that it might be able to replace stainless steel in certain applications at great reductions in weight.

Ryan began research on titanium at its own expense in August, 1951, and was one of the first companies in America to form this metal successfully by the drop-hammer process. Sections of complex shape were fabricated for exhaust system shrouds for Piasecki HUP-1 helicopters. One of these exhaust system sections has undergone tests of several

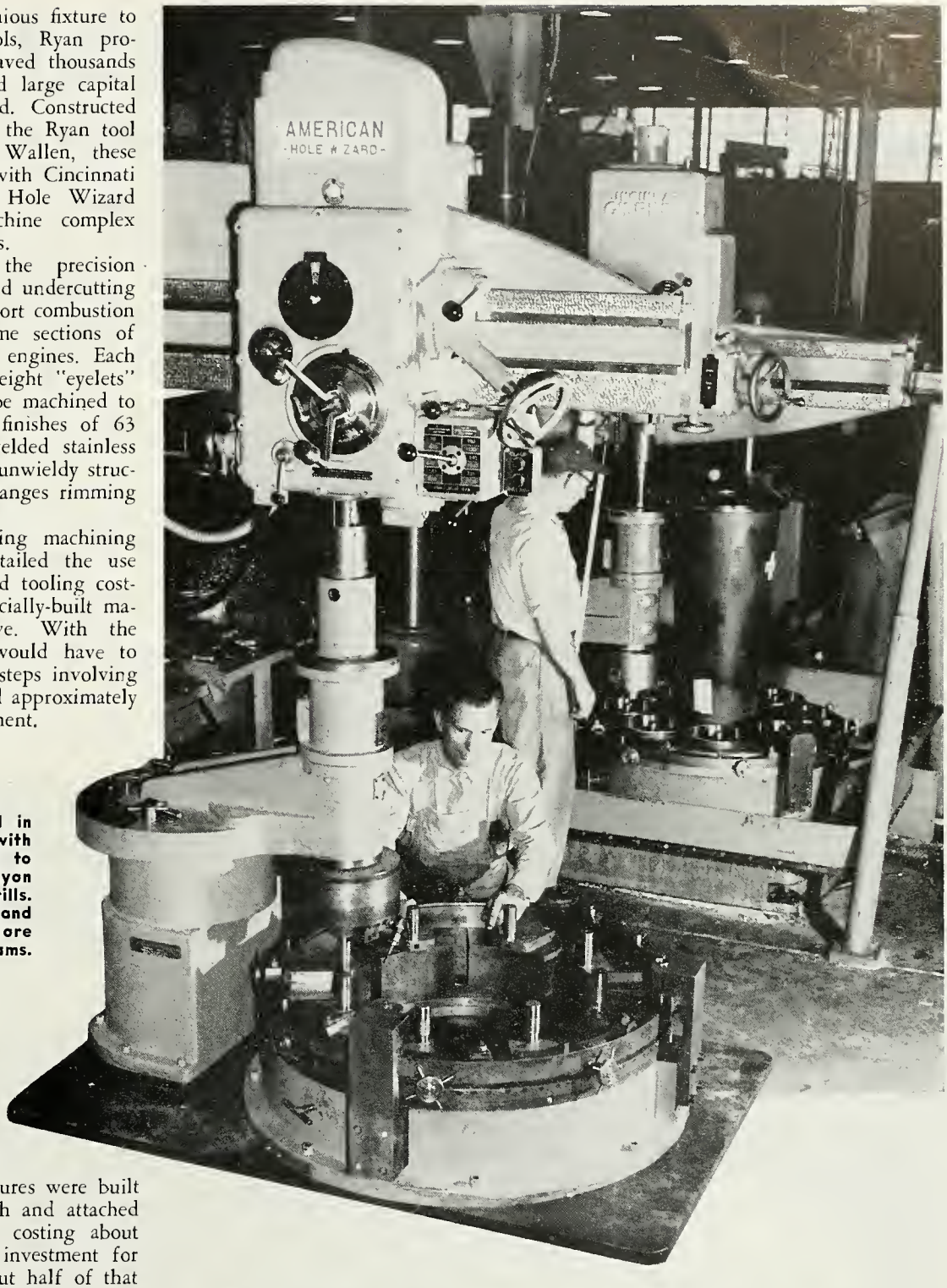
(Continued on Page 28)

INGENIOUS TOOL SPEEDS JET PARTS

BY harnessing an ingenious fixture to standard machine tools, Ryan production engineers have saved thousands of manhours and avoided large capital outlays otherwise required. Constructed under the supervision of the Ryan tool design engineer, H. F. Wallen, these boring fixtures are used with Cincinnati Bickford and American Hole Wizard radial-arm drills to machine complex components for jet engines.

The work involves the precision boring, turning, facing and undercutting of the flanges which support combustion chambers in the aft frame sections of General Electric J-47 jet engines. Each large aft frame contains eight "eyelets" and flanges which must be machined to tolerances of .005" and finishes of 63 RMS. Made of tough welded stainless steel, the aft frame is an unwieldy structure with closely-spaced flanges rimming its periphery.

To perform the exacting machining specified would have entailed the use of either boring mills and tooling costing $40,000 each or especially-built machines, equally expensive. With the boring mill, the work would have to be accomplished in four steps involving eight precision set-ups and approximately two days for each component.



Aft frames are machined in a tenth the time and with half the investment due to the special tools which Ryan has attached to radial drills. Milo Lavender (front) and William Ingels (rear) are operating these tool-teams.

The special boring fixtures were built at a cost of $13,000 each and attached to the radial-arm drills, costing about $9,000 so that the total investment for each machine tool is about half of that otherwise required. Most important is the fact that each aft frame can be machined in only two hours with the fixture, realizing a saving of nearly ninety percent in the manhours required by the use of boring mills for this job.

The Ryan fixture consists of two units; a boring head and holding fixture. The vertical spindle of the boring head is actually a shaft within a shaft which is attached directly to the radial arm

(Continued on Page 26)

GUIDED MISSILES

SCIENCE FICTION OR FEARSOME FACT?

By Dr. Louis N. Ridenour, Jr.

A top Air Force scientist reports that these "fantastic weapons" of our future wars are now rising from the drafting tables into airborne flight.

THE average taxpayer may be forgiven some mild curiosity about the vast missile development program that was undertaken, with lots of fanfare, after the close of World War II.

Has our missile program bogged down?

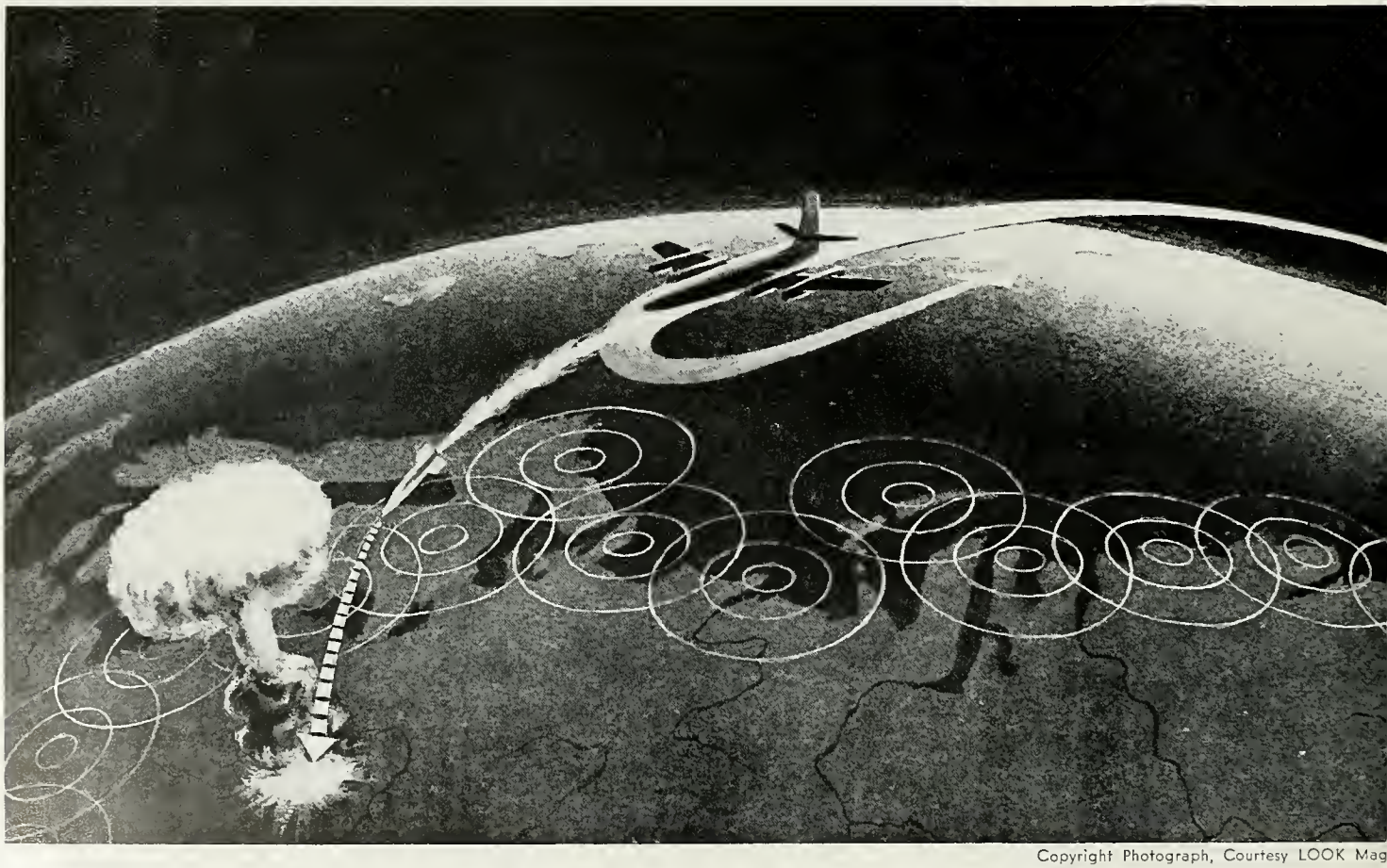
Are we in danger of lagging behind the technical progress of other nations?

What is the present situation?

Briefly said, guided missiles have emerged from their design-and-study cocoon into flight. During the past year, the Army has begun production of tactically useful missiles and is now activating combat units which will be equipped with two types. The Navy can now foresee the arrival of certain missiles with the fleet. The Air Force has flight-tested several missiles, including one which the Air Force had previously said would be ready for actual use before July 1 of this year. All in all, good progress is being made.

To understand the meaning of this progress, we must remind ourselves of the origin and purpose of guided missiles. Two different sorts of military tools have developed along lines leading up to "guided missiles": the ballistic missile, such as an artillery shell, and the piloted airplane.

Indeed, some types of guided missiles have been referred to as "pilotless aircraft," a designation that will probably lose its significance as development proceeds, just as it now makes little sense to refer to an automobile as a "horseless carriage."



Copyright Photograph, Courtesy LOOK Mag

Launched from bomber, beyond radar screen, an air-to-ground missile finds target through self-contained radio guidance system.

PILOTLESS AIRCRAFT

The term "pilotless aircraft" does emphasize, however, the evolution of one type of guided missile from the manned airplane. As aircraft speeds increase, operating altitudes rise and general performance improves, the demands that the flying machine imposes on its human pilot become all but impossible. It is not surprising that the trend in aircraft instrumentation has been mainly in the direction of supplanting the pilot with automatic mechanisms.

The recently announced Starfire jet interceptor, for example, has radar equipment which, once it sees the target, will automatically keep it locked in the field of view. It has a computing rocket sight which receives information from the radar, dictates the closing maneuvers of the interceptor and fires the rockets. The Starfire is more than halfway along the road from the manned airplane to the guided missile.

Airplanes can be much simpler when they do not have to carry human beings. They can execute maneuvers in which the centrifugal forces are limited by the strength of the flying machine, which

(Continued on page 12)

Copyright Photograph, Courtesy LOOK Magazine

Ryan "Firebird" air-to-air guided missiles are sketched in this LOOK magazine drawing by artist Ray Pioch. Booster rockets shown are jettisoned by explosive charge after original surge and four flight rockets propel missile on flight to target.

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Drawings by Ray Pioch

Physicist Dr. Louis N. Ridenour, Jr., 40, is member-at-large, Scientific Advisory Board, U. S. Air Force, and was formerly Chief Scientist, U. S. Air Force. During World War II, he was consultant to the Secretary of War. He edited M. I. T.'s 27-volume radar series.

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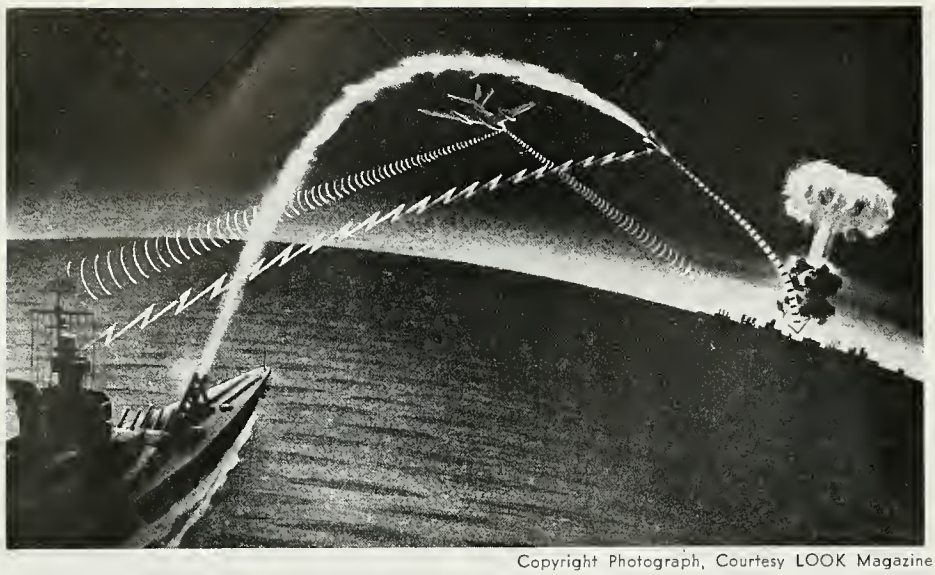

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Scout plane sights a far-off target and relays radar beam to battleship beyond the horizon. Ship sends surface-to-surface missile to target on projected radio signal.

the designer can make arbitrarily great, rather than by the 6-to-8 gravity-acceleration tolerance of the human body, whose design cannot be altered readily. Where an air-breathing man must have his whole body enclosed in a carefully pressurized and air-conditioned cabin, an air-breathing engine can deal with thinner air by means of bigger scoops and more powerful intake compressor.

Of course, a human pilot is highly adaptable; he can meet emergencies in an intelligent and effective way that machinery finds it difficult to match. But as the reaction time of an airplane decreases, he can finally issue to that plane only out-of-date commands. An automatic controller can be made to react faster by far than the most swift-moving plane.

Thus, one important class of guided missiles is the pilotless aircraft, derived from the first machine of the Wright Brothers. The airplane has entered a regime of performance in which it is difficult for a man to fly it, and automatic instrumentation is beginning to take over the job.

If this were everything involved in the trend toward guided missiles, the present picture would be simpler than it is. However, a second family of military materiel is culminating in the missile. This is the artillery projectile, such as the antiaircraft shell.

Radar defense picks up enemy bomber (1), signals fighter command (2). Fighter tracks bomber by radar (3), launches air-to-air missile with own radar for interception (4).

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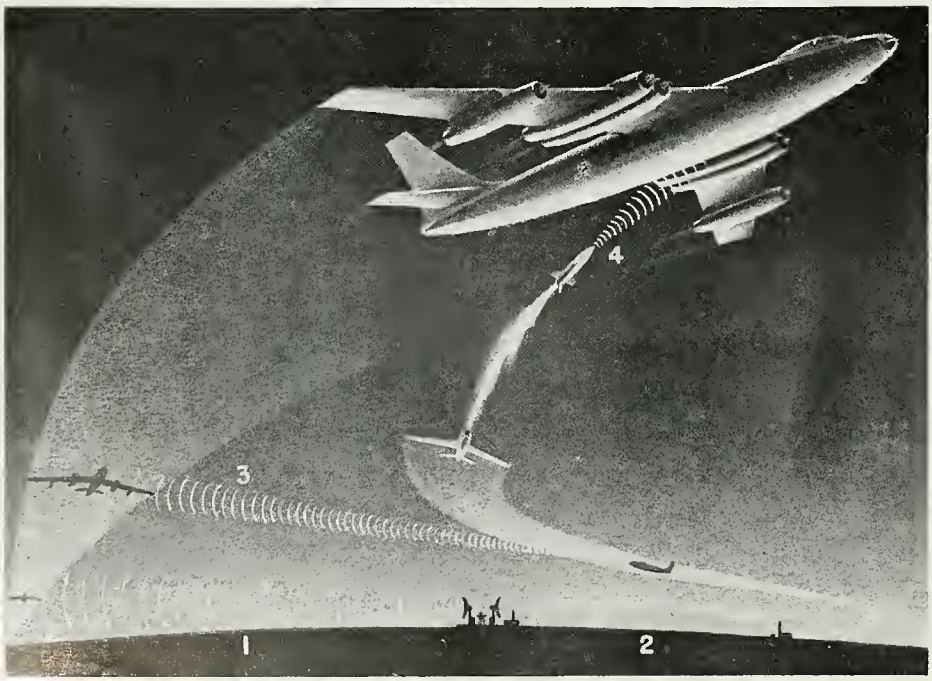


ARTILLERY MISSILES

Once it leaves the barrel of the gun, a shell cannot be directed. During the shell's time of flight to the expected position of the target, a high-speed enemy airplane will go several miles. Even if the airplane engages in no evasive action, the problem of hitting it is formidable. The idea of guiding the projectile toward its target, not just over the few feet of the gun barrel, but during the whole flight from launching to target immediately presents itself as a way to increase the accuracy and effectiveness of antiaircraft and other artillery. This has led to the ballistic type of guided missile.

It is clear that guided missiles will have vast importance in most future warfare. They will make our antiaircraft defense tremendously more effective.

Guided by extremely complex electronic systems of guidance, such missiles, flexible enough to include atomic warheads, are a development on which good work is being done. The Army has created one missile that can take off from the earth and track and destroy an airplane ten miles away and six miles high. The Army expects its Nike missile to tighten our aerial defense multifold.

Such surface-to-air missiles that can intercept invading aircraft are already a reality, and we are working on weapons which promise to deal effectively with enemy missiles themselves. The ultimate warfare may well see missile duel against missile.

We have also made important progress with surface-to-surface missiles which, because of their ability to function in all kinds of weather and because of their great range, are expected to give artillery an entire new dimension.

Air-to-air guided missiles will be used by our bombers as defensive weapons against whiplash attacks of faster-moving fighters. They will also be invaluable to our fighters attempting to intercept and shoot down invading enemy bombers. Guided missiles that can do these things are available today. The Navy, for example, already has a plane-to-plane missile effective at a distance of three miles.

The increasing relative speed of jet

(Continued on page 29)

Typical of the 84 heliarc welding stations in the Ryan plant is this one where Nile Barber is welding a stainless steel strut for a G-E jet engine. Automatic control of gas and water is assured by Ryan-built timer, with cover removed, on wall panel.

METER MISER

Simple, automatic and positive, Ryan's new welding "clocks" will pay for themselves in sixty days

Fred Pyzik installs argon gas bottles which Ryan uses at the rate of 572 a month in heliarc welding. New Ryan timer will save 115 bottles by cutting gas wasted in use.

AN ingenious new welding accessory, designed and built by the Ryan development laboratories will save $3200 a month at Ryan by taking the guesswork out of heliarc welding. The device is a unique argon gas and water control unit which is completely automatic and foolproof in operation. It is being installed in 84 heliarc welding stations where it will cut the $16,000-a-month argon gas bill by twenty percent.

To perform manual heliarc welding, the operator is required to turn on the flow of argon gas and water before striking the arc. The argon gas provides a blanket of inert atmosphere which protects both the tungsten electrode and the weld area from oxidation at the high welding temperatures. The water is circulated through the torch to cool it and the electrical cables.

When the arc is broken, the operator must wait from three to five seconds,

(Continued on Page 27)

Glenn L. Martin Company test pilots get instrument training in Ryan Navion. O. E. Tibbs, chief of flight test, is shown about to enter cockpit, and at right is George A. Rodney, manager of flight operations. Martin 4-O-4 airliner for T.W.A. in background.

BLIND FLYING IN A NAVION

SIMULATED instrument flying in a Ryan Navion enables The Glenn L. Martin Company's test pilots, who put Martin transports, jet planes and flying boats through their paces before delivery to the airlines, Air Force or the Navy, to obtain essential practice in instrument flying.

These test pilots are required to maintain a minimum of four hours flying time per month under simulated instrument flying conditions, explains O. E. Tibbs, Martin Chief of Flight Test. In their type of work test pilots do not have much opportunity to do instrument flying, since test flights are naturally made under good weather conditions.

However, Tibbs points out, it is essential that the pilots be competent and experienced in instrument flying, since it is always possible that a pilot may be caught in a storm or by low ceilings when on a test flight and have to bring the plane in by instruments.

After the war the Martin Company bought a surplus SNJ Navy trainer to

Martin's test pilots keep "sharp" by simulated instrument flying in a Ryan Navion

use for the purpose of giving test pilots the necessary practice in instrument flying but, according to Tibbs, "We found it expensive to operate, plus being of very little value to us as a utility plane."

About six months ago the Martin Company sold the SNJ and bought a Ryan Navion with a 205 hp. Continental engine in order to have a plane which would give them some additional usage, as well as providing practice in instrument flying.

Tibbs emphasizes that the prime purposes of the Navion for Martin is instrument training, and the plane has been very satisfactory for that purpose, since the stability and flight characteristics of the Navion are similar to the larger types.

The use of the Navion for practice makes possible an inexpensive way of keeping the proficiency of test pilots up to standard. There is a big investment in the cost of the large planes and their operating costs are too great to permit them to be used by pilots for such training.

When flying the Navion for instrument training purposes, Martin simulates conditions for instrument flying in the same manner as the airlines do. An amber- tinted plastic windshield is provided, while the pilot wears a helmet with a blue eye shield. The combination of the two colors block out the light entirely for the pilot, so as to simulate completely the conditions of blind flying. Martin has also modified the instrument panel of the Navion in order to represent that of the latest type transport panel, and familiarize the pilots with this type of panel.

Another feature of the Navion which makes its use very economical at Martin is that instrument training can be combined with utility flights. This was not possible with the SNJ, because there was no room for additional personnel. With the Navion, when one or two passengers are being carried, two pilots go on the flight for the purpose of instrument training.

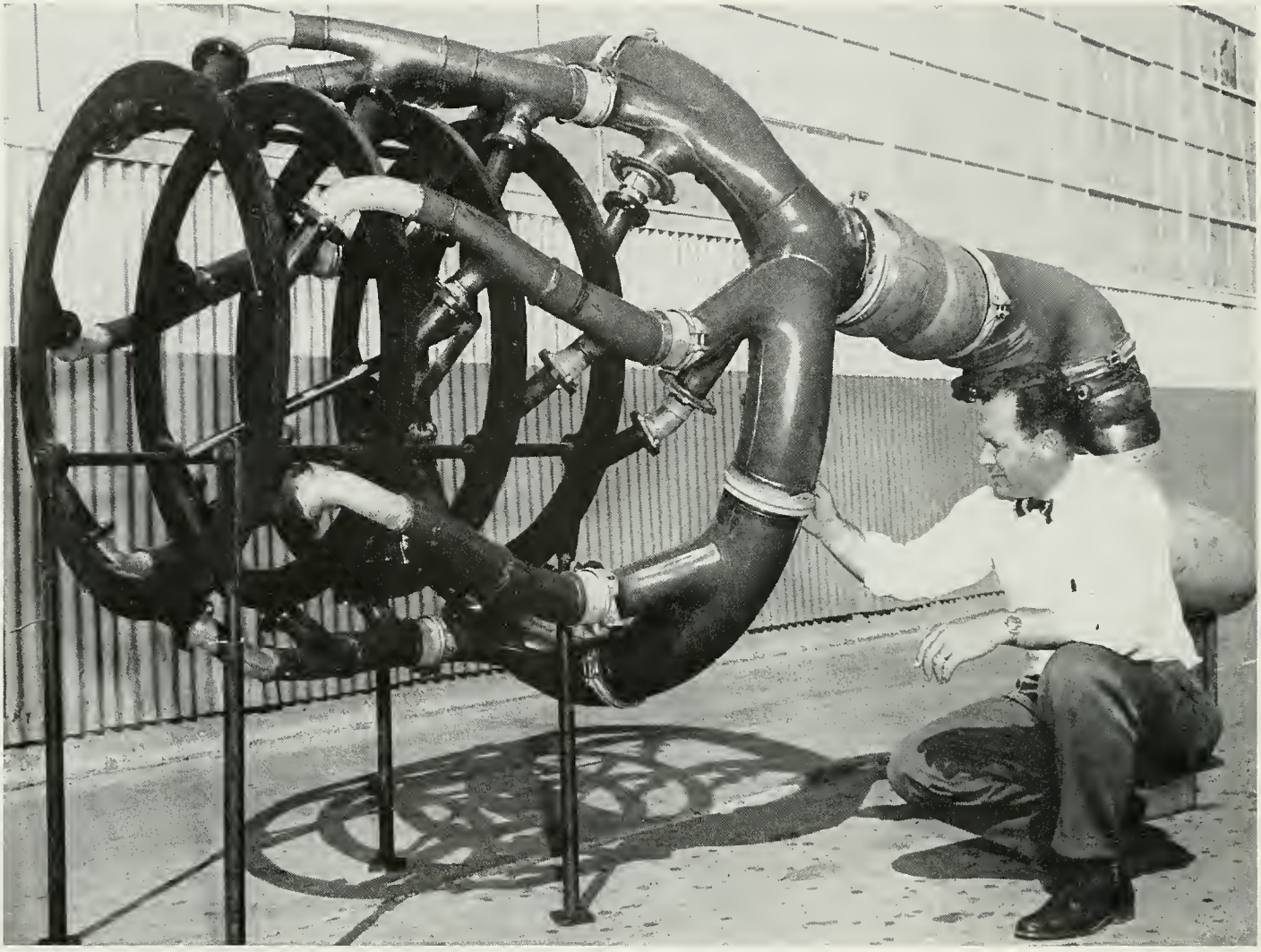
One of the important uses for the Navion by Martin Company is that of carrying flight crews from the Martin Airport to Patuxent Naval Air Test Center at Patuxent, Md., and to Wright-Patterson Air Force Base, Ohio. Four persons can be flown in the Navion, whereas the SNJ only accommodated one. The cost is one-third that of the SNJ, while the speed is virtually the same.

Another use which is made of the Ryan Navion at Martin is flying executives to and from Friendship International Airport. By car it requires one and a half hours driving time to go from the Martin Airport to Friendship Airport, through Baltimore traffic, but the distance can be flown by the Navion in ten minutes, thus saving many hours of valuable time.

The Ryan Navion purchased by the Martin Company is in use practically every day. In addition to its primary purpose, and the transporting of personnel, it is also used for hauling airplane parts.

The Navion has fulfilled all expectations, in the opinion of Tibbs, and he adds, "The plane is always ready to go when we want it, and the maintenance has been very low."

"Blackout" head shield, used for simulated instrument flying, is worn by George A. Rodney, flight operations manager of Martin. On the wing is test pilot, W. E. Smith.



EXHAUST SYSTEMS—Typical of the big ceramic coated structures which Ryan-Cameo is producing for aircraft is this complete exhaust system for a Pratt and Whitney 3500 h.p. engine of the Boeing B-50 Superfortress.

CERAMIC FACTS

IN this High Temperature Age when air power is in direct relation to the ability of metals to withstand the ever-increasing temperatures of jet, piston and rocket engines, the search for new materials and methods is being pressed forward on all fronts.

One of the most promising new techniques is in the field of ceramic coating. Much has been written; much has been said, about ceramic coatings. Claim and counter-claim have tended to confuse those seeking greater knowledge of the subject.

What are the FACTS?

What are its advantages; what are its deficiencies? Is the strength of ceramic coated steels, as well as their service life, increased? To what extend are present conclusions about ceramics backed by service testing and laboratory research? What ceramic materials have proven best? To what extent can strategic materials be saved by ceramic coating?

To give those interested in this new field authoritative answers to these and other questions, this report has been prepared by the largest producer of ceramics for aircraft —Ryan Cameo, Ryan Aeronautical Company and California Metal Enameling Company.

What Are High Temperature Ceramics?

Vitreous enamels which are fired under intense heat and fused to metals to protect them against the ravages of high temperatures and other deteriorating conditions. Derived from inorganic, earthy materials, they must be especially formulated to have the same coefficients of expansion as the metals to which they are bonded in order to adhere over wide temperature ranges.

What Special Properties Do They Possess?

They are extremely resistant to oxidation because they are saturated oxides. Many are corrosion-resistant. They have no definite melting points but gradually deform at greatly elevated temperatures. When used as very thin coatings, they have remarkably good thermal and mechanical shock resistance characteristics.

Why Are High Temperature Ceramics Important to the Aircraft Industry?

Ceramics offer a practical way to surmount the thermal barriers imposed by the sudden rise in power, and attendant temperature increases, of modern aircraft engines. Exhaust systems for piston-type power plants, "hot end" components for jet engines, afterburners, ramjets and rockets all have structures which must operate in the 1200° to 2000°F. temperature range—close to the limits which available metals can withstand under sustained service.

Are High Temperature Ceramics New in the Aircraft Industry?

Not as new as some believe. Original production work in this field was performed by the Ryan Aeronautical Company in 1944 when hundreds of exhaust systems for Douglas A-20 attack bombers, North American B-25 bombers and Rolls-Royce Merlin engines were ceramic coated. These protective coatings were applied to mild steel components in World War II in a successful effort to conserve diminishing supplies of stainless steels.

When Did High Temperature Ceramics Assume New Importance to the Aircraft Industry?

In 1947, when the National Bureau of Standards developed a revolutionary new formula for ceramic coating which could more successfully be used with stainless steels at high temperatures. The result of six years of concentrated investigation, this ceramic was the solution to the problem of obtaining a highly refractory porcelain enamel with the same coefficient of expansion as the stainless steels. Labeled "A-417," this ceramic has been improved by the National Bureau of Standards to the present "A-418" formulation.

How Have the National Bureau of Standards Ceramics Been Evaluated by Ryan in Service?

Through a series of actual flight tests mutually arranged by Ryan Aeronautical Company, Boeing Airplane Company and Pan American World Airways. Three years ago, Ryan built test exhaust sections of seven different high temperature alloys, including ceramic coated units, and installed these on the 3500 h.p. engines of Boeing Stratocruiser aircraft in scheduled Pan American transpacific flights.

At intervals of approximately 800 hours, these test headers were removed, analyzed in the Ryan Laboratories and returned to service. These tests are now approaching 3000 hours of flight experience.

Two years ago, Ryan extended these tests to the engines of three other global airlines: United Air Lines, Northwest Airlines and British Overseas Airways Corp. to obtain a world-wide evaluation of ceramic coatings on identical power plants under varying conditions of flight and service. More than 25,000 test hours have been accumulated and evaluated in these tests. In addition, important test data have been gathered on ceramic coated parts installed on Convair 240 Liners, Douglas DC-6 transports, Pratt and Whitney R-4360 engines, Douglas C-124 Globemaster II cargo transports and others. These are the most comprehensive flight tests that have been conducted to evaluate these ceramic coatings for application to exhaust systems in aircraft.

What Part Does California Metal Enameling Company (Cameo) Play in This Work?

From the beginning Ryan and Cameo have merged their experience and facilities because it was foreseen that this field demands the best in both metallurgical and ceramic know-how and equipment. With 41 years of experience, Cameo is the largest metal enameling firm in the West and has the only facilities in the West capable of applying high temperature ceramics on a volume production basis.

The Ryan-Cameo arrangement permits Ryan to concentrate its 30-year experience on the design and fabrication of high temperature structures suitable for ceramic coating and to provide the necessary laboratory and in-flight analyses which evaluate the work and guide future development. Also, large capital investments, for another modern ceramic coating plant are avoided, and substantial amounts of money are saved for Ryan customers.

Have the National Bureau of Standards Ceramics Been Evaluated for Application to Jet Engines?

Yes. Ryan-Cameo has provided the General Electric Company with test sets of combustion chambers and transition liners for the G-E J-47 jet engines which have been made of a less strategic metal and coated with National Bureau of Standards ceramic. Under actual engine running tests these components have demonstrated such good stamina that Ryan has received orders for thousands of similar chambers and the National Bureau of Standards ceramic coatings have been certified for these applications.

What Basic Developments Have Occurred as a Result of All These Tests?

The National Bureau of Standards high temperature ceramics have been recognized as highly successful in meeting the demands imposed by aircraft power plants and Ryan-Cameo has moved into the leading position in this field. Today, Ryan-Cameo is producing approximately 80 percent of all ceramic coated components for the aviation industry—more than 12,000 components per month.

How Do Metals Fail in the Blasting Heat of Aircraft Engine Applications?

Principally, in two ways:

(1) Through oxidation, which occurs on the surfaces of the metal and results in thinning of the metal wall. This is accelerated by elevated temperatures;

(2) Through embrittlement, caused by carbon absorption, which results in a loss of ductility and corrosion resistance of the metal. This phenomenon is contributed to by high temperature and the presence of the products of combustion.

How Do High Temperature Ceramics Prevent These Failures?

By carefully coating the surfaces of high temperature components with a very thin, properly prescribed coating of high temperature ceramic, the service life of these parts can be substantially extended. Coating prevents the occurrence of oxidation, embrittlement and loss of corrosion resistance. These phenomena have all been validated by both laboratory and flight tests conducted by Ryan-Cameo. Continuing tests are being conducted to determine the observed cooling effects exhibited by ceramic coatings.

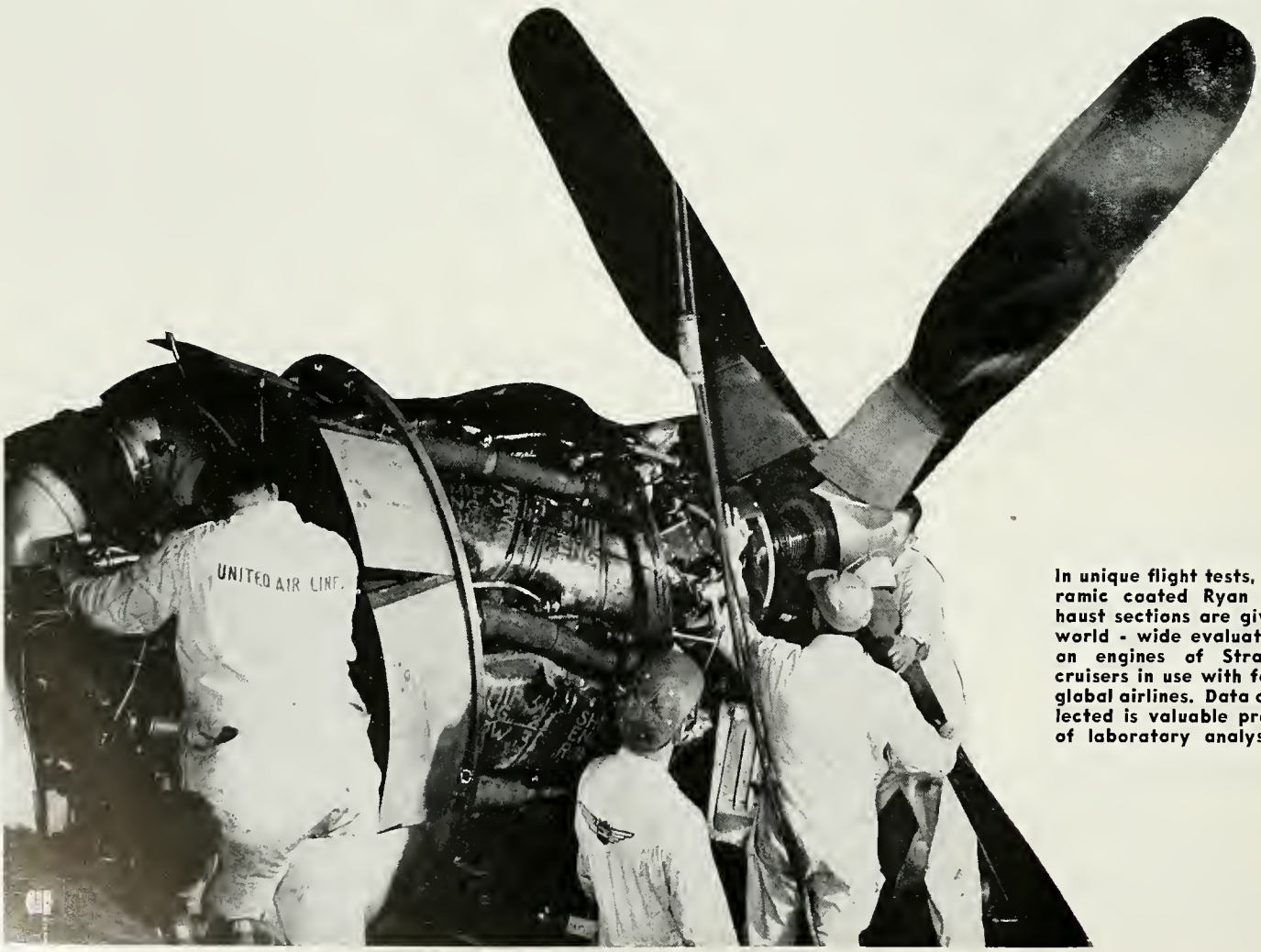
What Economic Benefits Do Ceramic Coatings Provide for Aircraft Applications?

Extending the life of high temperature aircraft components saves money, simplifies service problems and provides greater safety. Critically short metals are conserved in two ways: (1) longer component life; and (2) by the substitution of less critical alloys in applications where they would not otherwise be suitable.

What Are Typical Examples of These Advantages?

Ryan-Cameo has delivered 200 engine sets of ceramic coated exhaust systems for Convair Liners, 100 of which have already accumulated over 1800 hours each of flight service. Ryan-Cameo has delivered ceramic coated exhaust headers for all of the Boeing four-engined Stratocruisers in world-wide service. These parts have experienced a cumulative history of approximately 16,960,000 parts-hours. From laboratory examinations of these applications, Ryan-Cameo engineers estimate that the service life life of these components has been extended by an average of at least fifty percent.

By substituting Ryan-Cameo ceramic coated stainless steel for Inconel in combustion chambers for General Electric jet engines, a service life of equal or better duration has been attained under actual tests. Since these stainless steels contain only 8-11 percent nickel compared to the 75 percent nickel in the Inconel formula, a substantial saving in scarce nickel has been effected.



In unique flight tests, ceramic coated Ryan exhaust sections are given world - wide evaluation on engines of Stratocruisers in use with four global airlines. Data collected is valuable proof of laboratory analyses.

What High Temperature Ceramic Is Used in Greatest Volume for Aircraft Applications?

The National Bureau of Standards type "A-418."

Why?

Because this ceramic has demonstrated that it is the least affected by elevated temperatures combined with the other deteriorating conditions experienced in the operation of aircraft power plants and accessories. Also, this ceramic has excellent bonding and thermal shock characteristics when properly applied.

Ryan-Cameo laboratories have tested, and are continuing to test, every available high temperature ceramic, including the trade-named types, under simulated service conditions. Each is subjected to sustained temperatures, thermal shock, vibration and leaded fuel combustion. Using identical parts, temperatures, fuels and other test environment, the A-418 ceramic has proved its ability to withstand these tests with less deterioration than any other ceramic tested.

Why Are the National Bureau of Standards High Temperature Ceramics Most Efficient?

Because they contain the most successful blend of highly refractory compounds which meet the requirements for bonding with stainless steels. These ceramics are actually more difficult to apply and require more modern facilities because they fuse at higher temperatures than others. By adding specified ingredients, it is possible to lower this fusing temperature range and obtain an easier-to-apply ceramic. However, this could also adversely affect the high temperature properties of the ceramic.

In Applying A-418 What Are the Most Important Requirements?

Intimate bonding and uniform thickness. Metals tend to oxidize, in varying degree, at bonding temperatures and great care must be exercised to insure that oxidation will not prevent intimate bonding. Perfect bonding is demanded because the ceramic-coated metal must behave as a homogeneous material at all temperatures from about −60° to 1700°F. Uniformly thin coatings are a "must" because investigations have shown that they are the most efficient. Too thin coatings will not give adequate protection and coatings that are too thick will be susceptible to chipping. To obtain uniform coatings requires extensive experimental work and the finest in equipment.

Can Any Enameling Shop Perform Good High Temperature Ceramic Coating for Aircraft?

No. The requirements in this field are decidedly more critical than those for ordinary enameling of household appliances and similar goods because the temperature and service conditions are vastly different and more tortuous. Large, high temperature furnaces, special mill facilities for exact grinding needs, expensive application fixtures and modern laboratory facilities are a few of the basic requirements.

Probably the most important prerequisite is first-hand knowledge of aircraft power plant metallurgy plus the means for continually testing the product in actual flight environment. A world of difference exists between the facilities necessary for ceramic coating a few parts or samples and those required to turn out volume production of large, complex components.

What Aircraft Metals Have Been Successfully Ceramic Coated?

Ryan-Cameo has successfully ceramic coated the stainless steels, such as types 19-9DL, 347, 321, 310, 410, 430 and Armco 17-14 CuMo as well as the "richer alloys" of Inconel, Inconel X, Inconel W, Haynes Stellite N-155 and Hastelloy C. Also, the mild steel alloys of NAX, 1020 and enameling iron have been ceramic coated by Ryan-Cameo with good results. Ryan-Cameo is also working on new formulae for ceramic coating aluminum alloys, titanium and other metals interesting to the aircraft industry.

Will Ceramic Coatings Add Strength to Aircraft Structures?

No. Because the ceramic coatings are necessarily thin and possess low structural strength, they do not add to the initial strength of the metals to which they are bonded. Research to date has shown that ceramic coating will not bring the strength of a given material up to the inherent physical properties of higher-strength metals. However, these protective coatings permit the metal to retain much of its initial strength over a long service life at elevated temperatures.

Can Ceramic Coated Mild Steels Be Substituted for Stainless Alloys in Aircraft Applications?

Not in most cases. Most of the high temperature applications in aircraft engines involve high strength requirements as well as resistance to the effects of searing heat. Therefore, a mild steel must meet the structural needs of the application as well as withstand the physical-chemical effects to be suitable.

What Volume of Work Is Ryan-Cameo Capable of Handling?

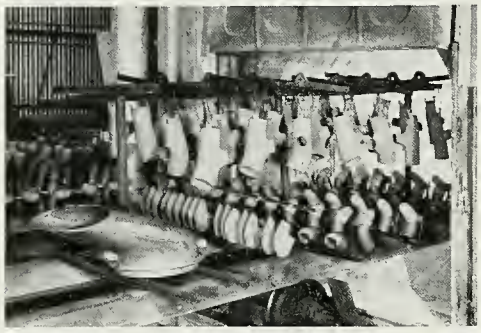
With presently installed and readily available facilities, more than three times the present volume of high-temperature components can be ceramic coated. This will permit the processing of more than 40,000 units per month.

What is the Future Course of Ceramic Development By Ryan-Cameo?

The two firms—Ryan in the field of high-temperature metallurgy, and Cameo in the field of applying ceramic coatings—are working hand in hand on a continuing research program. All new developments in high-temperature ceramics are being investigated. Basic research on new formulae and methods of application is being carried on.

A continuing research program is absolutely necessary because of the ever-increasing temperatures which will be encountered in the larger, more powerful jet, piston and rocket engines under development now and in the future.

In Cameo's V-bottom furnaces, Ryan exhaust components get a blazing bath of fire to fuse the ceramic coatings in perfect bond.

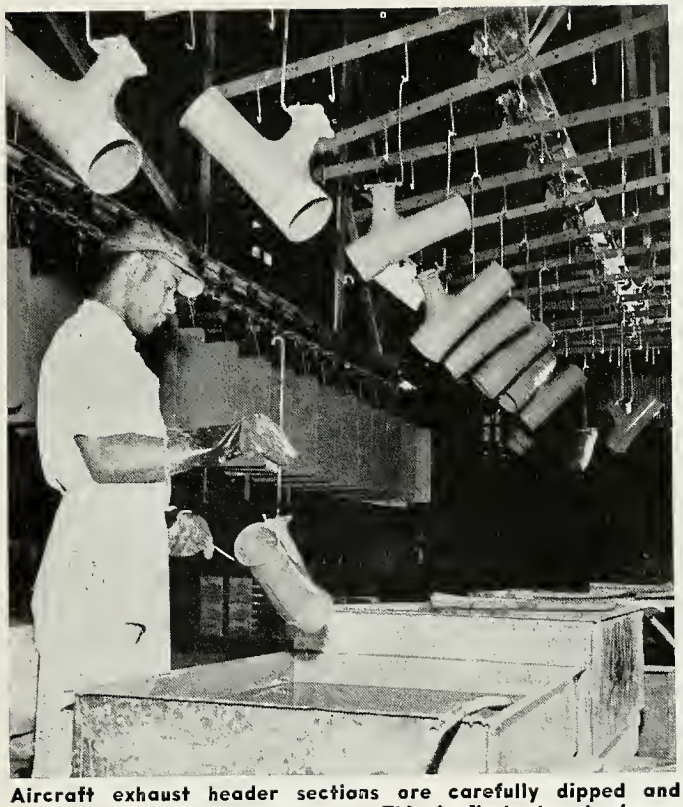


Parts for Boeing, Continental Motors and Fairchild are stacked in this furnace load.

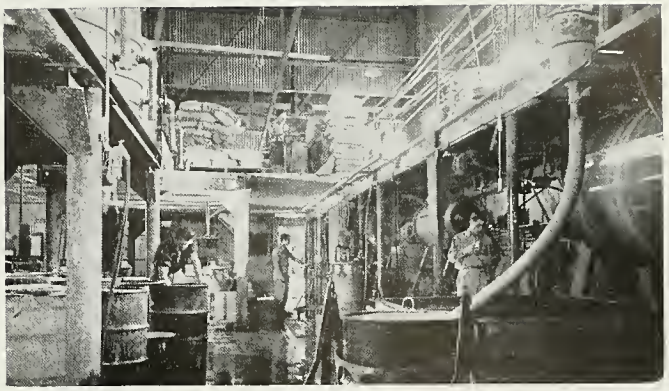
CERAMIC COATING FACILITIES

Because porcelain enamels have been used to protect metals in the form of finishes for bathtubs, stoves and other household appliances, many assume that ceramic coating aircraft components is a similar undertaking. Nothing could be more erroneous. High temperature ceramic coatings must be applied in very thin, uniform films which will endure in a furnace-like atmosphere where vibration, corrosion and combustion are constant factors. Only a handful of the metal enameling firms in the country have adequate facilities for performing this work—fewer yet can produce it in volume quantity.

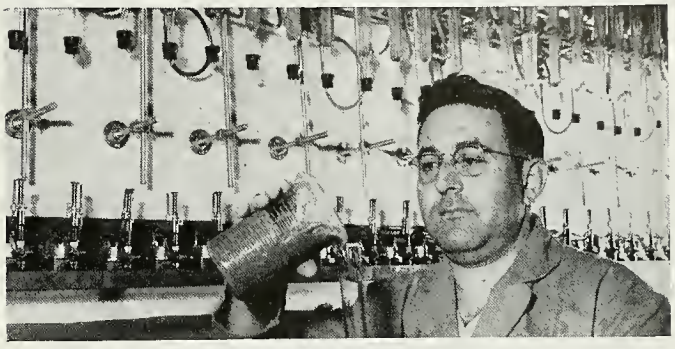
Geared for volume production, Cameo's plant is completely conveyorized with monorail which also circles through 100-ft. furnace.



Aircraft exhaust header sections are carefully dipped and drained on overhead conveyors. This is first step to insure that "slip" is applied with complete coverage to surfaces.

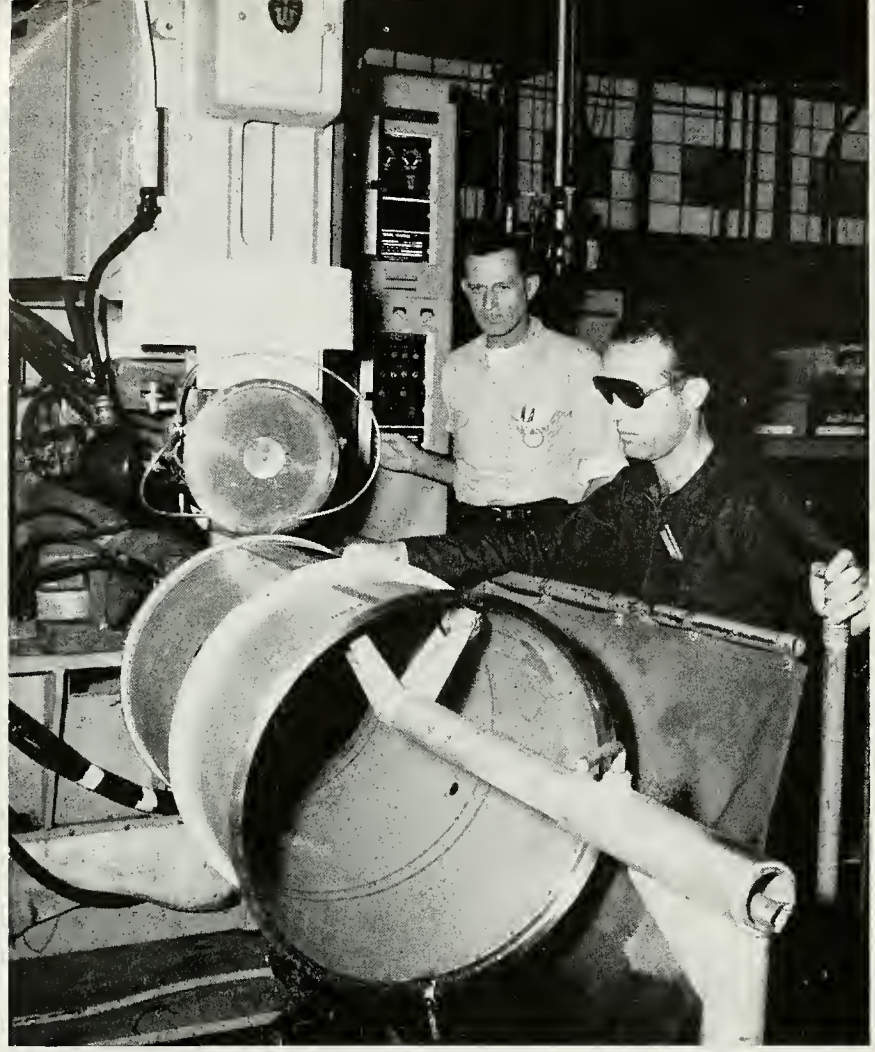


With ball mills, Cameo grinds ceramic ingredients to exact specification to attain the unique properties prescribed.



Cameo laboratory controls formula and processes of present coating and develops improved ceramics for needs of future.

Most modern facility in the West, this $100,000 straight-through 100-ft. furnace is example of Cameo's unexcelled equipment.



A jet tail pipe is spot welded at 68 inches a minute, three times the former rate, as engineer Steve Dever (left) checks John Cronin on a modified machine.

FASTER SEAMS with FEWER SPOTS

Ryan gets twice the production from spot welding machine with same personnel and floor space

WITH a new technique and modified facilities, Ryan spot welding engineers have stepped up welding speeds more than 100 percent and, at the same time, improved weld quality. Using specially equipped Taylor-Winfield machines, Ryan production is accomplishing gas-tight seam welds at more than 20 inches per minute compared with speeds of between 6 and 12 inches per minute formerly achieved. Spot welds on 1-inch spacings can be installed at over 60 inches per minute in contrast to the former rate of only 21 inches per minute.

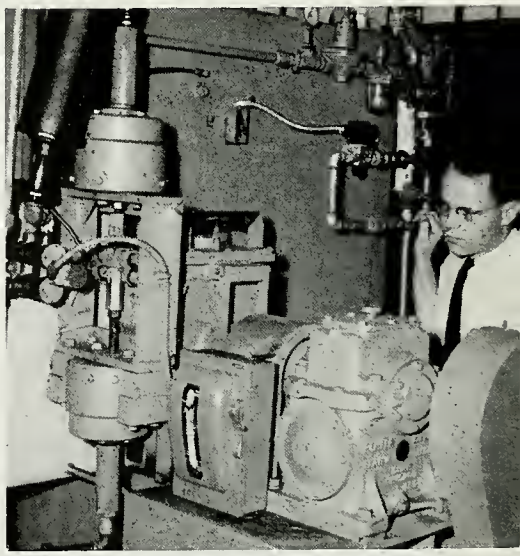
This accelerated performance is attained in the welding of tough stainless steels, Inconel X and W, Haynes Stellite No. 25 and other crack-sensitive alloys used in the fabrication of Ryan built afterburners, variable nozzles, exhaust cones, tail-pipes and high temperature jet engine components.

For this work Ryan is using new Taylor-Winfield machines which have been equipped with fast-indexing mechanisms for roll-spot welding. These devices are air-operated, electronically-controlled units consisting of two horizontally-opposed bellows which actuate an over-riding clutch. Powered by standard air line pressure of 80 psi., the clutch rotates the upper wheel electrode of the machine. By pressing a switch the continuous electric seam welding drive mechanism of the Taylor-Winfield is detached and the roll-spot drive takes over. It can be set by indicator to index in single or multiple movement and spot weld at spacings from zero to five inches.

The new controls are a distinct advantage over the Geneva-type drives used heretofore. With the Geneva drive, limited flexibility is available because the proportion between the dwell time and indexing time is a fixed ratio depending upon the gearing and drive mechanism. It can be varied in fixed increments only. The Taylor-Winfield air-operated drive provides infinite flexibility in varying dwell and indexing time ratios.

Although the new mechanism was de-

(Continued on Page 27)



Robert Fullerton, spot weld engineer, adjusts the split-second action of the Taylor-Winfield control which has been modified for maximum indexing speed.

FIERY FURNACE

(Continued from page 7)

to resume their normal configuration, the crystals resist deformation and residual stresses result.

Residual stresses can occur in two or three dimensions, perpendicular to each other, and are then particularly harmful because they inhibit shearing stresses that cause plastic flow. Consequently, ductility preceding fracture is reduced. In some cases shear can be so inhibited that yielding does not occur under stresses lower than the ultimate strength of the material.

No satisfactory method for determining the magnitudes and distributions of residual stresses, by nondestructive means, has been devised. Therefore, it is essential that they be removed from structures which are destined to carry critical loads in service. In the manufacture of aircraft exhaust systems, for instance, locked up stresses could reach a high stress level just short of structure failure. Under the influence of repeated loads in service, these stresses could develop excessive multiaxial tensile stress and cause early rupture.

Metal components which are not stress relieved in production will tend to stress relieve themselves when subjected to high temperatures in service because the heat encourages plastic flow in the direction in which the residual stresses are acting. This haphazard process would be ruinous to the function of precision-built jet engine assemblies, such as Ryan aft frame sections, which contain precision machined members. The realignment of the crystals would produce a distortion of all of the fine tolerances in the structure and throw bearing surfaces and other critical points out of alignment.

All residual stresses are not harmful. Often, these strains are deliberately induced in structures in order to increase their strength and life. For example, shot peening and cold rolling are common means for increasing metal resistance to fatigue by altering the range of tensile stresses near the surface where fatigue cracks start. In shrink-fitting assemblies together, such as gun barrels, compressive stresses are introduced which enable the parts to withstand higher tensile loading without yielding. In these cases the residual stresses oppose the working stresses imposed on the parts in function. If they add to the working stresses, they are harmful.

HEAT TREATMENT

To relieve residual stress, the structure must be relatively free to adjust itself under the force of their action. This can be accomplished either by imposing additional loading, mechanically, or by reducing the yield strength of the material, thermally. At Ryan, the latter method is employed because it permits a prescribed treatment which can be calculated for each alloy and condition of service. As metals are heated, their residual stresses are relieved and they become more and more "relaxed." Finally, they reach a state, called "true anneal," in which all tensions are removed and they are "dead soft" or as soft as they can be made to be.

In practice, stress relieving is performed at a compromise temperature which is sufficiently high to accomplish the desired relaxation but below the transformation point where crystalline structures, produced by previous heat treatment, are impaired. The effects of the stress relieving treatment are proportional to the time of exposure as well as the temperatures and often extended periods of treatment at reduced temperatures are substituted for higher temperature exposure to avoid deleterious effects.

G-E FURNACE

Largest and most efficient of the new furnaces installed at Ryan is the General Electric-built model used to stress relieve aft frame sections for G-E jet engines. This towering two-story furnace (shown on cover) contains a huge brick-lined heating compartment which is supported on steel columns nine feet above the factory floor. An ingenious loading car, containing ten aft frames, rolls under the furnace and is hoisted by electric motors to form the furnace bottom. By loading vertically, through the bottom of the furnace, heat losses are reduced to a bare minimum.

Heating is produced, electrically, by a continuous conductor which is coiled in the fire brick interior of the furnace. Sealing of the furnace bottom is effected by means of a knife-edge metal strip, running along the bottom of the furnace, which descends into a sand trough located along the periphery of the car. The sand seal is designed to be air tight for the normal pressures of one-and-a-half inches of water but will blow out in the event excessive pressures accumulate in the interior.

Most metals oxidize when heated in air. The oxidation attack rate increases as temperature rises and occurs with varying intensity over the surface. This discontinuity of attack is due to the anisotropic properties of the crystals which present different faces to the exterior and, consequently, exhibit varying degrees of chemical reaction. As a result, oxidation produces a rough, uneven surface accompanied by loss of metal even though the oxides are completely removed by acid bath treatment. Naturally, this phenomenon cannot be tolerated in jet engine components where metal surfaces must be smooth, true and held within a few thousandths of an inch.

To prevent oxidation of the aft frame sections while they are hot, the General Electric furnace is purged of all oxygen and filled with a neutral atmosphere during the entire heating and cooling cycles. This is accomplished by a special gas generator which partially burns city natural gas until its oxidizing agents are removed. Then, with the furnace sealed, the neutral atmosphere is pumped through for forty five minutes prior to heating, to remove all air. Excess gas passes through a vent in the furnace bottom which is closed after purging.

With purging completed, the automatic electronic controls are set and the entire heating and cooling cycles are accurately regulated without employee supervision. Usually, temperature is brought up at a steady rate of 200° F. per hour until 1650° F. is reached. This temperature is held until the stress relief is accomplished and the furnace is cooled at a regulated rate prescribed by metallurgists. Normal cooling can be augmented by passing the circulating atmosphere through water cooled tubes.

Because the furnace is heated electrically it can be completely sealed without the necessity for disposing of products of combustion. Temperatures, pressures and atmospheric conditions are completely under the control of the operator. This command also extends to the cooling phase which is equally important in stress relieving structures of very close tolerances. Slightly too rapid cooling can induce new residual stresses. Sudden cooling could cause residual stress by thermal shock which would be just as harmful as

(Continued on next page)

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the stresses previously removed by the heat treatment.

LINDBERG FURNACE

Undoubtedly, the most unusual new furnace to come to Ryan is the Lindberg continuous model. Made by the Lindberg Engineering Company of Chicago, Illinois, this unique unit is designed to perform heating and cooling simultaneously, in separate compartments. Parts are fed into the facility by means of an endless chain conveyor belt which passes over steel drums that are rotated by electric motors.

The hottest heat treating furnace at Ryan, the Lindberg unit can operate at 2100° F. and may be used for furnace brazing. It is heated electrically through globar heating elements which are spaced above and below the conveyor in the heating compartment. After passing through the heating chamber, the belt carries parts through three successive cooling compartments in which the temperatures and atmospheres are also controlled. Cooling is effected by water circulating through surrounding jackets.

Oxidation is prevented by controlled atmospheres which are generated and pumped through all parts of the furnace. These gases are obtained by partially burning natural gas and passing the products over a catalyst to enrich them in hydrogen and carbon monoxide. Because of the heavy concentrations of these gases, the atmosphere obtained is actually a reducing gas which will remove oxides as well as prevent their formation. Black, oxide-coated steel can be run through the furnace to emerge as a bright, shining metal.

By continually charging the Lindberg furnace with controlled atmospheres an internal pressure of approximately 2 inches of water is created which prevents air from entering. Although there are doors at each end, the furnace may be operated with these open and fibre glass curtains used to prevent the emergence of flames.

Ryan is using the Lindberg furnace to stress relieve rocket motors which must be built to minute precision and completely "relaxed" before beginning their short but spectacular life.

INDUSTRIAL SYSTEMS FURNACE

Because they are substantially larger than other jet engine components, Ryan afterburners posed a special problem in heat treating. This was resolved by Industrials Systems, Inc. of Los Angeles, California, who designed and built a large gas-fired furnace to meet Ryan specifications. The design incorporates a number of interesting innovations.

To accommodate the tall afterburners the heating compartment was designed as a large brick-lined structure without bottom and with a front door entry. In a concrete pit, directly in front of the furnace, two mobile loading cars can be loaded from adjacent floor-level platforms. By means of a hydraulic piston, these cars are switched from the loading platforms to the center tracks which lead into the furnace. When loaded with three afterburners, one car is rolled under the furnace bringing the afterburners into the heating compartment. Electric motors hoist the car six inches and close the heavy steel sliding doors to effectively seal the compartment.

ALTHOUGH this facility is not a completely controlled atmosphere type, satisfactory regulation of atmospheric conditions is maintained through an ingenious combustion arrangement. The gas burners are located along the top sides of the furnace. Air and gas are injected, separately, in proportioned amounts into a special combustion chamber at the top of the furnace. Only sufficient air for supporting combustion is automatically valved in order that no excess amounts are present to cause oxidation.

The hot gases are forced down into the heating compartment through slot-like openings in the fire-brick ceiling. They circulate through the afterburners, pass through ducts near the floor and rise in the furnace walls to again enter the combustion chamber. Pressure in the furnace is maintained at from one to two inches of water and excess gas is vented off from the furnace top.

In addition to stress relief, this furnace also accomplishes age hardening of the alloys used in the afterburners. This especially tough alloy, designed to withstand the extreme temperature encountered in afterburner operation, attains its maximum strength through heat treatment. This treatment is deferred until the structure has been fabricated, to render it more ductile for forming, and is then applied along with the stress relief heat treatment. At a temperature of 1450° F., the afterburners are stress relieved and age hardened to top strength.

KNAPP FURNACE

In the recently installed Knapp furnace, Ryan has obtained a larger capacity heat treating facility of similar type to those which have proved their usefulness at Ryan over a number of years. These furnaces are gas-fired, electrically-controlled ovens which are used both for heat treating exhaust systems and jet engine components.

In the forming of stainless steel alloys for aircraft exhaust systems one or more heat treatments are required to anneal the metals. This is due to the deep-contoured designs of modern manifolds and the definite tendencies of the stainless steel to work-harden rapidly under forming. By heating these stampings to the 1800-1980° F. range, the residual stresses caused by forming are relieved and the metal is softened so that further forming can be performed without risking cracking.

Ryan plant engineers have designed and built quick loading mechanisms for the Knapp furnaces which permit the loading of parts, hydraulically, through push-button control. This has resulted in greater safety for operators, by removing them from the proximity of hot parts, and faster furnace operations with less heat loss through open doors.

These furnaces are not controlled atmosphere types but effective regulation of the amounts of air entering the furnace can be arranged through air and gas mixture controls. In this way, a reducing atmosphere is attained in the furnace so that there is slight oxide formation while the parts are in the furnace. These furnaces do not have controlled cooling cycles or atmospheric regulation when the parts are removed from the heating compartment so that oxide scale forms as soon as the parts are removed from the hot interior and the cold air strikes them.

RYAN removes this oxide scale through a series of acid baths which pickle the metal back to a bright finish. In the process, some metal is lost but these exhaust system parts are not critical in dimension to the extent that the loss of a few ten thousands in thickness will affect their usefulness.

A clear trend can be discerned in the arrival of these four types of heat treating furnaces at Ryan. That is the continued refinement of a process, which was once a rather simple application of heat, to a closely controlled technique which is laboratory-like in its precision. This technological advance is due, in general, to the stepped up speeds which aviation has embraced and particularly to the development of the jet engine.

In this progress the interdependency of all science can be observed. Increased aircraft performance has demanded the best from aircraft and power plant designers. They, in turn, have asked for better metals from metallurgists. These experts have drawn upon every phase of physical science to better understand the exact nature and behavior of metals in order to glean the utmost from them. The net results are evidenced in the new techniques for heat treating as well as in other manufacturing processes where the research laboratory is playing a dominant role.

SHOCK TREATMENT

(Continued from page 3)

Ryan plant engineers designed the inertia blocks to attain the most desirable insulation characteristics and maintain the impact force of the machines. From this data, it was determined that the total force to be transmitted to the foundation, for the larger installation, would be 342,500 pounds. This figure governed the number and capacity of isolating springs used.

For physical reasons, the vibration frequency of the machine should be considerably different than that of the isolating medium. If this proportion were reduced to a one-to-one ratio, the machine would be in resonance with its foundation and a dangerous condition would exist. Under this condition large amplitudes of motion and excessive forces can be transmitted. For this reason, marching troops are cautioned to break step when crossing a bridge. Otherwise, the vibration frequency of their march might be resonant with the natural oscillation rate of the bridge causing the full impact of their marching energy to be simultaneously transmitted to the bridge structure.

In operation, the inertia blocks receive the impact of the Cecostamps, hesitate momentarily and depress the supporting springs 3/8 of an inch. The huge foundations oscillate until the energy is dissipated, through friction.

Coiled steel springs are an ideal elastic material because they can be precisely designed to deliver specific capacities. Their characteristics depend upon their dimensions, design and heat treatment and not upon varying materials such as rubber and cork. Also, steel springs have a damping coefficient of less than one-half of one percent. Damping subtracts energy from the machine, in the form of heat, and places an added strain upon the foundation.

The Ryan plant is built upon sandy soil dredged up from the San Diego Bay. This soil was not considered suitable for sustaining the Cecostamp's foundations because of its low bearing characteristics. The foundations would tend to sink and the soil would have an undesirable damping effect upon the foundations. Consequently, pilings were driven to a depth of 50 feet where a layer of shale underlies the sandy soil. These were capped with a three-foot thick concrete cap. The concrete pits were poured on top of these caps.

The machine operators stand upon a floor which is cantilevered over the inertia block and are not inconvenienced by the movement of the hammer.

By making the pits larger than the contained inertia blocks, good access to all steel springs is provided so that they can be replaced in the rare event that breakage occurs. Because of the very short deflection experienced, the springs are practically indestructible.

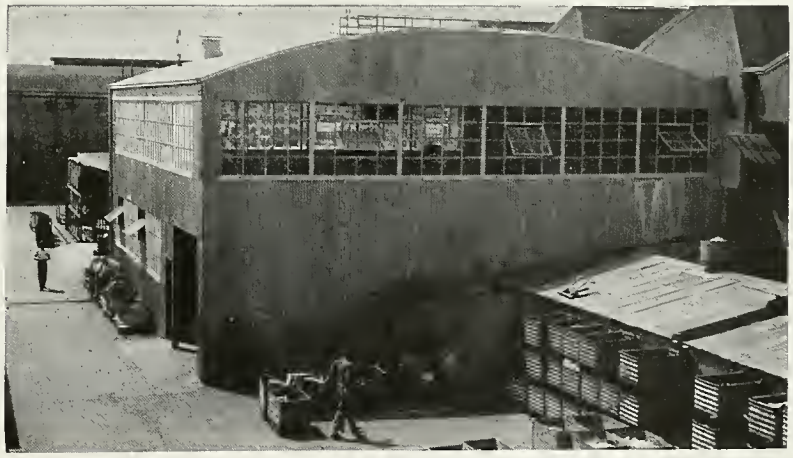
A distinct advantage of this method of mounting machines is the excellent facility for keeping them in plumb. Usually, under continued pounding, the foundations of this equipment will shift out of plumb. This causes erratic work and can pulverize wearing timbers, damage machine bases, etc. With the floating foundation, the machine can be kept in perfect plumb by simply adjusting the leveling jacks which are located at each spring mounting.

NEW PLANT FACILITIES

Expansion continues at Ryan Aeronautical Company as plant space must be enlarged to accommodate the tremendous increase in machinery being installed for accelerating production schedules.

Two new structures have been built, both as extensions of the main factory building. One (See picture below) is being used to house four giant metal-stamping machines; two Cecostamp air-driven hammers and two drop-hammers. These devices rest on pilings that have been driven 50 feet into the bottom of the Bay (Ryan is located on Lindbergh Field, which is land reclaimed from San Diego Bay). The other structure has permitted expansion of manifold welding activities not only through provision for additional equipment, but through rearrangement of existing tools to expedite production flow. (See picture above).

In addition to this physical plant enlargement, Ryan has completed its most extensive paving program in many years to improve parking and outdoor production and storage areas. More than 304,000 square feet of paving has been laid down, the largest project being provision of parking space for hundreds of cars at the west end of the plant. The parking problem has grown with the increase in payroll during the past two years.



INGENIOUS TOOL SPEEDS JET PARTS

(Continued from page 9)

drill by means of a sheer pin. At its other extremity it is fitted with circular cutting head which holds four sets of dual carbide-tipped cutting tools. Each pair includes a rough- and finish-cut tool.

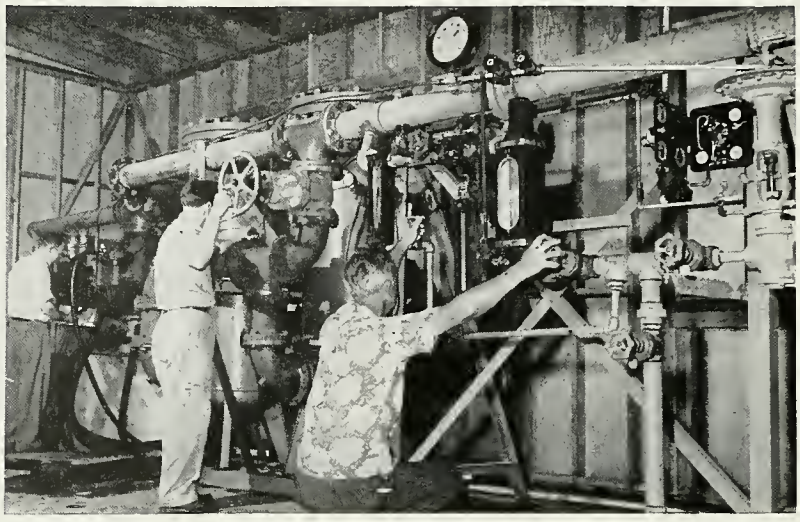
The holding fixture is a heavy cast iron assembly which rigidly holds the aft frame and rotates on ball bearings to permit indexing of the unit.

Using the radial-arm drill as a source of power and feed, the boring head spindle rotates and descends, automatically, bringing the cutting head into contact with the flanges. The first pair of cutters bore the inside diameter of the flange. When this operation is completed, the further descent of the head brings the second cutters into action to turn the outside diameter. Care is taken to insure that these machining operations do not overlap so that vibration from one will not interfere with the other.

When the turning is accomplished, the outer shaft descent is stopped by a pilot and the inner shaft continues to descend. This actuates bell cranks which move a third pair of cutters, horizontally, to face the top of the flange. Then, the last cutters are brought into play, by cam action, to undercut the flange on a bevel.

Since each operation of the sequence follows in rapid order, exact timing of the action is necessary. This is obtained by a special Ryan-devised system of timing pins which are grooved into the shafts to positively coordinate the motion of the parts.

The cycle of operation is automatic and the operator is required only for loading and unloading the machine and indexing the aft frame. Swinging cranes, with air-operated hoists, are located at each machine so that one man can perform the loading. The radial drill arm and boring head are easily swung to one side to allow room to load the holding fixture. Water-soluble oil is pumped to the cutting head, from a collecting reservoir, to remove heat generated by friction.



EARTH BOUND FLIGHT

These men are not operating the diving controls for the new atomic-powered submarine — but they are working with a Ryan project which is also in the "hush-hush" category. They are testing Ryan-built rocket motors which are used to power guided missiles and high altitude rockets on their streak through space.

Although rocket motors have a phenomenal appetite for fuel in flight, there's nothing haphazard about the amounts consumed. Ryan engineers must know exactly how much each motor will burn before it begins its spectacular mission. To do this a novel technique is used which employs a $12,000 combination of plumber's fittings and engineering instruments.

Under the direction of Bert Holland, rocket project engineer, and C. C. Hasty, plant design engineer, the interesting-looking flow test arrangement, pictured above, was designed and built. The system pours huge volumes of water through the rocket motors and carefully measures the amounts and pressures. By substituting water for rocket fuels and applying conversion factors to correct for varying viscosities, densities, temperatures and other variables, Ryan engineers can determine the complete hydraulic characteristics of each motor without firing it.

The water is brought in through a 5-inch line. Two tons of water per minute can be gushed through the system. It is regulated in pressure, measured and filtered before coursing through the rocket motors. At the controls above (left to right) Wallace Adams, Lawson Martineau and Allan Walker are observing the flow meter, which indicates rate of flow in pounds per second, and the pressure gauges, which show pressures in pounds per square inch. From these figures, Ryan engineers can calculate the pressure drop through the motors and develop the hydraulic characteristic curves needed to chart performance.

To prevent corrosion of the polished rocket surfaces, the water is passed through two large filters which remove every particle larger in diameter than 10 microns. A micron is one-millionth of a millimeter and a millimeter is about one twenty-fifth of an inch. Undoubtedly, this water is the cleanest water in San Diego from a physical standpoint.

The unique flow test facility is assuming increased importance because of the stepped up production of rocket motors which Ryan is building for the Firestone Tire and Rubber Company and for Douglas Aircraft Company.

FOUR WAY DUTY

(Continued from page 5)

haul payloads of up to 34 tons on normal missions. Pressurization provides sea level cabin pressure up to 15,000 feet altitude. At 25,000 feet, cabin pressure is maintained at 5,500 feet.

At March Air Force Base, the two squadrons of double-decked aerial tankers are being trained toward the day when these planes will accompany other noted Boeing aircraft, the B-29 Superfortresses; anywhere in the world, not only as "flying service stations," but as troop transports or hospital planes as the need arises.

First of the KC-97F tankers arrived at March Air Force Base last June. A huge special maintenance dock has been erected to handle 100-hour inspections, Many of the ground crew men formerly maintained the B-50 bombers, which closely resemble the KC-97F's.

America's first line of defense—the Strategic Air Command—now has a new means of extending its effective striking range, thousands of miles from home soil.

METER MISER

(Continued from page 13)

to allow the electrode to cool sufficiently, before turning off the argon gas. Substantial amounts of gas are wasted in these starting and stopping procedures because the welder must depend upon his memory and judgment to control the time cycle. Necessarily, he must allow an excessive flow in order to be sure to exceed the minimum intervals.

Usually the argon gas control is incorporated in the hook upon which the welding torch is hung. Consequently, if the operator stops welding but does not hang up the torch, the argon gas flows continuously. Frequently, it is necessary to stop welding to shift the part, pass over holding jigs or clean the torch. On these occasions the welder often does not hang up his torch and gas is wasted.

The Ryan gas-saving control is the product of the combined thinking of six development laboratory men: William Cockrell, Director; Don Heyser, Ford Lehman, Robert Fullerton and Fred Dever, welding engineers, and Wilson Hubbell, metallurgist. It consists of a few simple relays and condensers all of which are standard electrical parts with the exception of one special relay constructed by the laboratory. It contains no tubes or motors and requires no adjustments either for varied work set-ups or because of wear.

The timing cycle is started by means of a microswitch located in the foot pedal voltage regulator used for heliarc welding. As the operator depresses the pedal to obtain increased voltage for striking the arc, the microswitch is closed. This energizes two interdependent circuits, one of which immediately actuates two solenoid-operated valves to start the flows of gas and water. At the same time a condenser in the circuit is charged and begins to dissipate its current. It takes eight seconds for this condenser to discharge. If the arc is not struck within this 8-second interval, the discharge of the condenser opens another relay which turns off the gas and water valves. If the arc is struck within eight seconds, the gas and water valves are kept open until the arc is broken. At that moment the automatic timing cycle is established.

The 8-second interval is an inherent property of the condensers selected and is inevitably sequenced when the arc is broken regardless of what the operator does or does not do. Although five seconds is sufficient time to cool the electrode to safe temperature, it was found that an 8-second timing was better coordinated with the welder's work habits. In eight seconds he could break the arc, shift the work and resume welding without having to re-establish the timing cycle with his foot pedal.

Unlike some commercial controls, the Ryan unit is not sensitive to voltage. Consequently it is not rendered inoperative if the welder raises the foot pedal after striking the arc or when the voltage is deliberately reduced near the end of the weld seam. Also, it does not have to be adjusted in order to respond to the different voltages required for varied types of work.

It is completely positive and automatic under all welding conditions and requires no attention from the welder. He cannot strike the arc unless the gas and water valves in the control are open thus eliminating the hazard of burning the valuable tungsten electrode. He is relieved of all concern about supervising the gas flow and can devote his skill to the welding itself to increase his production and reduce occurrence of defects.

Ryan has developed a hang-up switch which disengages the timing control from the welding equipment for use on twenty machines where both heliarc and metallic arc welding are performed from the same generators. The operator can switch from heliarc to metallic arc welding by simply hanging up one torch and picking up the other. Ryan has applied for patents covering the design of the gas-saving time control.

Research Officer Inspects Ryan Project

Another of the high-ranking officers who have shown keen interest in a new Ryan jet engine development visited the plant recently to inspect the project. He was Capt. J. N. Murphy, executive director of the research and development group, Navy Bureau of Aeronautics, shown above with T. Claude Ryan and engineering personnel at jet test cell control panel. Left to right, C. A. Ackerman, H. O. Braasch, Bruce Smith, Comdr. Cedric Stirling, local Bureau of Aeronautics representative, (partly hidden), Capt. Murphy, Ryan, Ed Sly and I. W. Keith (latter two at control panel).

FASTER SEAMS WITH FEWER SPOTS

(Continued from page 22)

veloped to accomplish spaced out spot welds at increased speeds, Ryan spot weld engineers Robert Fullerton and Fred Dever have conceived another application for it—faster seam welding. With continuous drive machines, certified, gas-tight seam welds could not be formed at speed exceeding 6 to 12 inches per minute in the crack-sensitive alloys. When these rates were exceeded, the metal temperature rose to the point where undue shrinkage and distortion occurred and cracks developed.

Careful analysis of this phenomenon disclosed that it required a large number of overlapping spot welds to produce gas-tight seams with continuously rotating electrodes because each spot weld was inferior to that produced under static conditions. Consequently, Ryan technicians directed their efforts toward attainment of the speediest intermittent operation commensurate with high quality.

The Taylor-Winfield drive was speeded up even beyond its already rapid action. Exhaust mufflers were changed and a design which exhibited less back pressure was installed. A Ryan-improved air intake valve, with snappier action, was incorporated. A new type of faster-meshing

(Continued on next page)

Financial Experts View Jet Assembly Work

Financial experts from the Southern California area, including members of the Los Angeles Stock Exchange, and financial writers for various publications, viewed Ryan production methods on a special trip to San Diego recently. They were escorted through the plant in several groups and were given thorough explanations of the processes in manufacturing the wide variety of products turned out at Ryan.

One such group is shown above watching assembly of inner combustion chamber for General Electric J-47 jet engine by E. E. Morris, metal fitter. Escorted by William Brotherton, of the Ryan public relations office (extreme left), the observers were, left to right, Robert Sandifer, of the Los Angeles Times; Malcolm F. Morlan, trader, Harbison & Henderson, Los Angeles; Howard Rutledge, of the Wall Street Journal; Colin W. Travers, registered representative, Lester, Ryons & Co., Carona del Mar; and Peter C. Olmstead, registered representative, Dempsey-Tegeler & Co., La Jolla.

FASTER SEAMS WITH FEWER SPOTS

(Continued from page 27)

gearing is being developed by Ryan to provide more speed.

With these facilities, Ryan engineers worked out new performance ratios in which time was compressed to the minimum. Dwell time, during which the electrodes are motionless, was reduced to the shortest possible interval but kept long enough to produce sound spot weld structure. Indexing time, which is time lost in making the switch to the next spot weld location, was also cut to the bare minimum. Because of the flexibility of the equipment, these time ratios could be coordinated for different materials and thicknesses with complete freedom.

Once precision control of intermittent operation was attained it was found that better spot welds could be accomplished than under continuous operation. The spot weld nuggets were sounder because the metal was held under forge pressure during the cooling cycle and a larger, stronger nugget was made. Also, by holding the sheets during cooling, shrinkage and distortion from heat were greatly reduced.

With sounder spot welds available, it became evident that gas-tight seam welds could be formed with fewer spot welds and at greater speeds. This has proved to be the case. For instance, on a typical Ryan afterburner assembly formed from two sheets of .045" Inconel W, Ryan previously had to install 11 overlapping spot welds per running inch to form certified seams under continuous drive. Because of the proximity of the spot welds, this work could not be done at speeds exceeding 12 inches per minute due to the heat accumulated. With the new roll-spot technique, Ryan is performing certified seams with only five-and-a-half spot welds per inch and can make 26 inches of seam per minute.

For spaced out spot welding, the new technique is equally satisfactory. In spot welding a General Electric J-47 jet engine tail-pipe Ryan installs 300 spot welds on one inch centers in one seam. These can be installed at 68 inches of seam per minute compared with the former rate of only 21 inches per minute under standard methods. With improvements now being developed, speeds of 80 inches per minute will be realized. This reduction in time allows Ryan to spot weld five of these assemblies in the same time which was required to do two with previous means.

Economically, the innovation presents an attractive picture. The Taylor-Winfield accessory drive costs about fifteen percent of the cost of a new machine. For that amount, it is quite possible to get twice the capacity from a machine, making it perform the work of two, without devoting added personnel or floor space to the job.

NEW TITANUIM CONTRACT

(Continued from page 8)

hundred hours and the titanium is being analyzed to determine the effect of high temperatures.

Known as the "Dr. Jekyll and Mr. Hyde" metal, titanium is a paradox of nature, exhibiting strangely contradictory characteristics.

It has an extremely high melting point for its weight—higher than steel—but it will not withstand continued use at temperatures above 1,000 degrees F. Titanium falls between the aluminum and steel alloys in both strength and resistance to temperature. It therefore has qualities of great interest to aircraft engineers, who have been forced to use the heavier stainless steel in designing structures which required more strength than aluminum alloys could provide at high temperatures.

While aluminum alloys lose strength rapidly when temperatures exceed 300 degrees F., titanium can retain its unusual strength up to temperatures of approximately 800 degrees F. Yet it weighs only 56 per cent as much as steel, and compares favorably with steel in tensile strength (as high as 200,000 pounds per square inch).

Titanium has a lower linear coefficient of expansion and thermal conductivity than either aluminum or steel alloys. It also is the only metal known to have an endurance strength consistently in excess of 50 percent of its tensile strength.

Titanium is not a new discovery, but its use in the aircraft industry is new. Its presence has been known since 1791, but it was not produced commercially until 1946, when the U. S. Bureau of Mines developed a process for separating it from its ore. Although titanium is plentiful in the earth's crust, production costs are tremendous due to its affinity for the ore. The refined metal costs $10 to $20 a pound, compared with the two cents a pound market price for the ore. In 1950 only 60 tons of the metal were refined.

One of the research avenues explored by Ryan is the experimental use of ceramic coatings on titanium to determine whether these may provide protection against oxidation and absorption. Ryan was an industry pioneer in demonstrating the success of such coatings when used with stainless steel alloys in the hottest spots of aircraft engines.

GUIDED MISSILES

(Continued from page 12)

airplanes in combat has reduced the effectiveness of ordinary guns as aircraft armament. The unguided rockets with which the Starfire is armed are better than guns, since they give a bigger volume of fire in the split second of best aiming, but an aerial "homing torpedo"— a missile which, once fired, seeks out its target and destroys it—is better still.

Another missile dream, one even more immediately promising, is the tactical guided missile—the missile designed to perform the classical function of interdiction of the battlefield, or to give close support to embattled ground troops.

The Air Force has announced its Matador, a medium-range pilotless jet plane of high performance which can do the interdiction mission. But the difficulty with interdiction missiles is to know what the target is and the best time to hit it.

This, then, is a taxpayer's summary of where the $2 billion have gone. Within the formal rules of secrecy, we have gathered here a few of the facts.

Though guided missiles for several roles are in progress, at various stages of development, it must not be said that today's arms will be replaced immediately.

Has the missile program been worth the investment?

The answer to this question can only be an unqualified "yes." Not only is it true that guided missiles represent an inevitable evolutionary development which we could not have avoided even if we had wished; it is also true that many valuable side effects have been produced by the missile program. To mention only a few: The reliability of electronic devices—condensers, vacuum tubes, resistors—has been vastly increased by the requirements of the missile designers. The development of modern computing machines has been greatly hastened by the demands of missiles. We have learned more about supersonic aerodynamics than the program of development of manned aircraft would have taught us in a decade.

If our missiles have to go to war, we can expect drastic changes. No one can foresee exactly the outcome of the moves and countermoves of a real war.

All that we can say now is that the basic technique of the new missiles seems to be coming into reach, and that, for the future, our success will be dependent on our adaptability, a commodity of which we've never been in short supply.

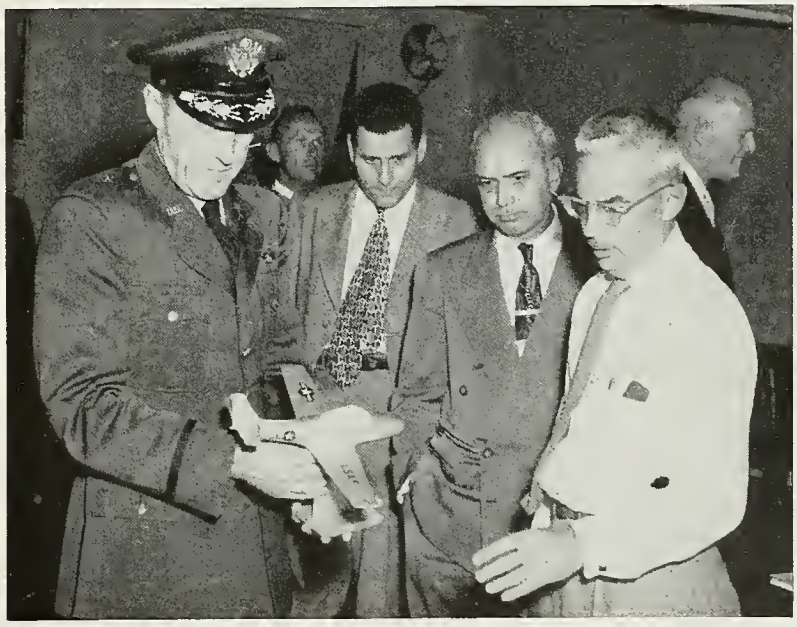
K. T. Keller, Director of Guided Missiles for the Secretary of Defense, is shown Ryan techniques by L. M. Limbach, Works Manager, and T. Claude Ryan, company President. At extreme right is Lawrence D. Bell, President of the Bell Aircraft Corp., who accompanied top guided missile experts to Ryan.

Research Experts Inspects Ryan Projects

Two of America's top experts in the "future look" of aviation viewed advanced new projects in visits to the Ryan Aeronautical Company plant recently. First here was K. T. Keller, on loan from Chrysler Corp. (where he is chairman of the board) as Director of Guided Missiles for the Secretary of Defense. He expressed great interest in Ryan's facilities for producing pilotless aircraft and rocket engines. With Keller were Army, Navy and Air Force specialists and Lawrence Bell, President of Bell Aircraft Corp.

They were followed by Brig. Gen. Albert Boyd, commander, Wright ADC, one of the nation's foremost speed pilots. He expressed interest in a confidential airplane design project under development at Ryan, as well as Ryan's entry in the Air Force jet trainer competition, and the Q-2 jet-propelled pilotless target aircraft now in test program.

Brig. Gen. Albert Boyd, commanding general, Wright ADC, inspects model of Ryan L-17B liaison plane during recent visit. With Boyd are Don Tuttle, of Ryan engineering; T. Claude Ryan, and Bruce Smith, Engineering Director. In background, Charles Ackerman and Al Deyarmond, Ryan engineers.



RYAN AERONAUTICAL COMPANY
P. O. BOX 311
SAN DIEGO 12, CALIFORNIA

RYAN

Aircraft and Aeronautical Products

Leaders in High-Temperature Metallurgy

for

JET, PISTON AND ROCKET ENGINES

Ryan's Metal Products Division has taken the lead in solving one of the toughest problems facing the aircraft industry—that of making high-temperature components that will better stand up to the intense heat developed in modern jet, piston and rocket engines. To do this, Ryan has assembled a staff of highly skilled, experienced metallurgical and ceramic engineers... and developed a physical plant equipped with some of the largest and finest high precision machine tools in the industry.

Manufacturing components for the "hot spots" in present-day piston engines requires the best equipment and most modern methods of forming, welding, precision machining and assembly. Ryan's "follow-through" service after shipment, and extensive field testing experience, is unmatched in the industry.

Ryan
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